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AIR FORCE CAMBRIDGE RESEARCH LABORATORIES

L. G. HANSCOM FIELD, BEDFORD, MASSACHUSETTS

Bibliography, With Abstracts, of AFCRL Publications From 1 July to 30 September 1972

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AIR FORCE SYSTEMS COMMAND
United States Air Force



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Abstract

This bibliography lists all AFCRL in-house reports, journal articles, and contractor reports issued from 1 July to 30 September 1972.

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**Bibliography, With Abstracts,
of AFCRL Publications
From 1 July to 30 September 1972**

INTRODUCTION

This bibliography lists all AFCRL in-house reports, journal articles, and contractor reports issued during the reporting period. The DD Form 1473 (Document Control Data - R&D) for each publication is included.

In Part I, the 1473's for in-house reports are arranged numerically by the series in which they were issued; in Part II, the 1473's for journal articles are arranged alphabetically by author; in Part III, the 1473's for contractor reports are arranged alphabetically by corporate author. For cross-reference purposes, an index is included, listing the publications numerically by the AFCRL document number.

Types of AFCRL Reports

AFCRL technical reports include those prepared in-house and those prepared by contractors. The in-house reports are issued in six series, and the contractor reports are of two types. The in-house series and the types of contractor reports are described below.

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This series is utilized for two types of environmental research information: (a) research results that are directly applicable to design, developmental, or operational problems of the Air Force, and (b) survey or state-of-the-art papers in a specific area of the environmental sciences.

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TRANSLATION SERIES

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Contractor Reports**SCIENTIFIC REPORTS**

Scientific Reports are normally prepared when a definable phase of the research has been completed, when the research effort reaches a point where it is natural and logical to summarize the results, or if no other scientific report was issued during the contract year. Scientific Reports cover all phases of work

undertaken during the period of the report, including the contents of papers published in scientific journals or presented at scientific meetings.

FINAL REPORTS

These reports summarize the work performed under the contract.

How to Obtain Copies of AFCRL Technical Reports

The reports listed in this bibliography can be obtained by agencies of the Department of Defense, their contractors, and other government agencies from:

Defense Documentation Center
Cameron Station
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All other persons and organizations desiring copies of AFCRL technical reports should apply to the:

National Technical Information Service (NTIS)
Springfield, Virginia 22151

Part I
AFCRL In-House Reports
by Series

Air Force Surveys in Geophysics

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Security Classification

| DOCUMENT CONTROL DATA - R&D | | |
|--|--|---|
| (Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) | | |
| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LWH) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE EARTH MOTIONS AND THEIR EFFECTS ON INERTIAL INSTRUMENT PERFORMANCE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Robert A. Gray Francis A. Crowley Thomas S. Rhoades Gerry H. Cabaniss Henry A. Ossing Leslie B. Thompson, Maj, USAF | | |
| 6. REPORT DATE 27 April 1972 | 7a. TOTAL NO. OF PAGES 63 | 7b. NO. OF REFS 56 |
| 8a. CONTRACT OR GRANT NO. 7628-09-01 | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0278 | |
| b. PROJECT, TASK, WORK UNIT NOS. 7628-10-01 | | |
| c. DOD ELEMENT 62101F | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFSG No. 239 | |
| d. DOD SUBELEMENT 681000 | | |
| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LWH) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT <p>A limiting factor in realizing the ultimate sensitivity and associated system accuracy of the more advanced inertial guidance instrumentation is the adverse influence of earth motions on performance. Motions of concern to inertial guidance testing and operations are categorized as propagating and non-propagating. Propagating motions include earth background noise and seismic events while non-propagating motions include local and regional tilts, earth tides, polar wobble, irregularities in earth rate, and precession. Motion measurement philosophy and instrumentation are discussed. Of the several methods available for obtaining transmissibility estimates for inertial test pads and missile silos, the finite element approach offers the notable advantage of minimum computational requirements, flexible computation mesh, and facility for the insertion of pre-stress. Considering the total motion environment, the most significant impact on gyro performance will be due to propagating motions and tilt. Estimation theory principles can be used in predicting and removing motion-induced errors from inertial instrument performance. KEYWORDS: Environmental motions, Seismic motions, Crustal motions, Motion induced errors, Geodetic motions, Inertial instrument performance, Gyro testing, Inertial guidance systems, Missile guidance systems</p> | | |

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| DOCUMENT CONTROL DATA - R&D <i>(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)</i> | | |
|---|--|--|
| 1. ORIGINATING ACTIVITY <i>(Corporate author)</i> Air Force Cambridge Research Laboratories (LKI) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | | 2b. GROUP |
| 3. REPORT TITLE HOW DRY IS THE SKY? A DECADE LATER AND THE SST | | |
| 4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Scientific Report. Interim. | | |
| 5. AUTHOR(S) <i>(First name, middle initial, last name)</i> Norman Sissenwine Arthur J. Kantor Donald D. Grantham | | |
| 6. REPORT DATE 27 April 1972 | 7a. TOTAL NO. OF PAGES 27 | 7b. NO. OF REFS 29 |
| 8a. CONTRACT OR GRANT NO. | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0294 | |
| b. PROJECT, TASK, WORK UNIT NOS. 8624-01-01 | 9b. OTHER REPORT NO(S) <i>(Any other numbers that may be assigned this report)</i> AFSG No. 240 | |
| c. DOD ELEMENT 62101F | | |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKI) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Water vapor that would be added to the stratosphere by a potential fleet of SSTs is related to the most accepted humidity balance in the stratosphere based on general circulation considerations, and to moisture introduced into the stratosphere by vaporization from convective clouds. A mean residence time of 25 months for water vapor was calculated from general circulation values. On the assumption that other water vapor reaching the stratosphere has an equal time of residence, a fleet of SSTs would increase humidity by 0.5 ppm or 25 percent of the generally accepted 2 ppm equilibrium value. Vaporization of only 1 percent of the convective cloud mass, calculated herein to enter the stratosphere, would increase its mixing ratio by 1 ppm. Recent limited measurements of vaporization from convective cloud intrusions into the stratosphere over the United States were extrapolated to yield an addition of nearly 1 ppm to Northern Hemisphere stratospheric humidity. Other evidence suggests that vaporization is about 5 percent of this cloud mass. This would account for an increase in stratospheric humidity, averaged uniformly between 50,000 and 100,000 ft, of 5 ppm. | | |
| KEYWORDS: Stratospheric humidity, Stratospheric water balance, SST pollution | | |

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| (Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) | | | |
| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LIB) L. G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP | |
| 3. REPORT TITLE ARCTIC IONOSPHERE MODELLING – FIVE RELATED PAPERS | | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | | |
| 5. AUTHOR(S) (First name, middle initial, last name) George J. Gassmann Charles P. Pike Jurgen Buchau Martin G. Hurwitz Rosemarie A. Wagner | | | |
| 6. REPORT DATE 16 May 1972 | | 7a. TOTAL NO. OF PAGES 59 | 7b. NO. OF REFS 76 |
| 8a. CONTRACT OR GRANT NO. | | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0305 | |
| b. PROJECT, TASK, WORK UNIT NOS. 5631-14-01 | | | |
| c. DOD ELEMENT 61102F | | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFSG No. 241 | |
| d. DOD SUBELEMENT 681310 | | | |
| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LIB) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT <p>This volume contains five self-contained but closely related papers each dealing with one or more aspects of modelling the Arctic ionosphere. The papers supplement and update previous papers on the same subject and, together with those, constitute part of the ingredients from which eventually an Arctic Ionosphere Model can be produced. J. Buchau (<u>Instantaneous Versus Averaged Ionosphere</u>) points out that the practice of averaging ionospheric parameters has resulted in a smooth and unrealistic picture of the Arctic ionosphere and that a new approach in synoptic analysis is essential. Computing radio and radar propagation in the Arctic requires a quasi-instantaneous specification of the ionosphere and of its time dependency. It is argued that even for assessing the average propagation conditions, an averaged ionosphere does not provide a shortcut. What is known about the Arctic ionospheric layers and how they may be modelled is described in analog form by R. A. Wagner (<u>Modelling the Auroral E-layer</u>), G. J. Gassmann (<u>Model of Arctic Sporadic E</u>), and C. P. Pike (<u>Modelling the Arctic F-layer</u>). Those descriptions show omissions, gaps, and uncertainties and are subject to current research at AFCRL and elsewhere. J. Buchau and M. G. Hurwitz (<u>Coordinate Conversion and Other Computer Programs for Arctic Ionospheric Research</u>) and also C. P. Pike in his paper report on a number of computer tools. Those programs provide conversion from geographical into geomagnetic coordinates and vice versa, with options to plot airplane and satellite tracks in either of these coordinates and with options to plot selected experimental data.</p> <p>KEYWORDS: Sporadic E, Night-E, Auroral ionosphere, Polar ionosphere, Geomagnetic coordinates, Ionospheric modelling</p> | | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LKI) L. G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | | 2b. GROUP |

3. REPORT TITLE

EXTREMES OF HYDROMETEORS AT ALTITUDE FOR MIL-STD-210B

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific. Report.

5. AUTHOR(S) (First name, middle initial, last name)

Norman Sissenwine

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| c. DOD ELEMENT 62101F | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFSG No. 242 | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKI) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT Extremes of precipitation aloft—which would be exceeded with only 0.5 percent probability in the rainy tropics during the雨iest months—are mandatory for design of military equipment that must operate at altitude any place in the world. Also needed are greatest extremes at altitude which should be considered in design when equipment failure, during encounters of improbable intensities, would endanger human life. Frequency distributions of such rainfall intensities and the associated liquid water content in the precipitation and clouds are not available in the climatic inventory.

By extrapolating upward, there are developed nearly instantaneous surface precipitation intensities with appropriate probabilities, utilizing available research data, four models, and tabulations of water content aloft. The maximum mandatory precipitation rate aloft is 1.08 mm/min at 4 to 6 km. Associated water density in the precipitation and clouds totals about 5.5 grams/cm³. When life is endangered, however, values associated with the world record 1-min rainfall, nearly 50 times this great, are a goal. Other goals, when design for this very improbable world record is not feasible, are included. Complete findings are presented in a single table which includes intensities, liquid water content of precipitation, and liquid water content of cloud particles for nine levels up to 18 km for storms applicable to MIL-STD-210B design philosophy.

KEYWORDS: Military standard, Design criteria, Hydrometeors, Precipitation

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (PHE) L. G. Hanscom Field Bedford, Massachusetts 01730 | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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3. REPORT TITLE

GROUND-BASED COSMIC-RAY INSTRUMENTATION CATALOG

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)

M. A. Shea

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| 6. REPORT DATE 17 July 1972 | 7a. TOTAL NO. OF PAGES 220 | 7b. NO. OF REFS 9 |
| 8a. CONTRACT OR GRANT NO. | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0411 | |
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| c. DOD ELEMENT 61102F | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFSG No. 243 | |
| d. DOD SUBELEMENT 681311 | | |

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PHE) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT

A comprehensive listing of ground-based cosmic-ray detectors in operation from 1932 through 1971 has been assembled and the pertinent information and data availability of each sensor is given. The cosmic-ray instrumentation cataloged consists of neutron monitors, muon detectors and ionization chambers.

KEYWORDS: Cosmic rays, Cosmic-ray detectors, Neutron monitors, Muon detectors, Ionization chambers

Environmental Research Papers

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| (Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) | | |
| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LYU) L. G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| 2b. GROUP | | |
| 3. REPORT TITLE RESULTS FROM THE AFCRL RADAR METEOR TRAIL SET | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Arnold A. Barnes, Jr. Joseph J. Pazniokas | | |
| 6. REPORT DATE 17 March 1972 | | 7a. TOTAL NO. OF PAGES 88 |
| 8a. CONTRACT OR GRANT NO. | | 7b. NO. OF REFS 83 |
| b. PROJECT, TASK, WORK UNIT NOS. 8628-08-01 | | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0185 |
| c. DOD ELEMENT 62101F | | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) |
| d. DOD SUBELEMENT 681000 | | ERP No. 392 |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYU) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT A description of the data taken at AFCRL from 1964 through 1966 and the methods of analyzing the wind data are presented. A least squares fit to the mean, 24-hr, and 12-hr components of the wind was applied to the data, and the results are compared to those obtained by other investigators. The mean meridional flow was from the summer pole, with the zonal winds from the west except near the time of the equinoxes. The phase and amplitude of the 24-hr component were not steady, but the 12-hr component was strong and steady except for slow seasonal variations and for rapid changes near the equinoxes. The 24-hr component of the wind was found to rotate counterclockwise during a couple of periods, and this may be interpreted as a downward propagation of energy by the diurnal tidal wind. Vagaries of the observed 24-hr wind component may, therefore, be attributed to the fact that energy is being propagated upward from sources in the lower atmosphere and/or lithosphere by one diurnal tide and is being propagated downward from another energy source. Individual heights derived from the decay-rates of underdense trails are of little value; however, they do contain enough height information to be useful for statistical purposes. In particular, this means that a simple but powerful radar with a narrow beam antenna would be capable of providing useful climatological results on the mean winds and tides and their variations with height. | | |
| KEYWORDS: Winds, Density, Mesosphere, Meteor trails, Tides, Energy propagation | | |

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| (Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) | | |
| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LYC) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | | 2b. GROUP |
| 3. REPORT TITLE | | |
| ATMOSPHERIC CORRECTIONS FOR AIRBORNE RADIATION THERMOMETERS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) James F. Church, Lt Col, USAF Paul F. Twitchell | | |
| 6. REPORT DATE 26 April 1972 | 7a. TOTAL NO. OF PAGES 33 | 7b. NO. OF REFS 26 |
| 8a. CONTRACT OR GRANT NO. | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0277 | |
| b. PROJECT, TASK, WORK UNIT NOS. 6670-08-01 | | |
| c. DOD ELEMENT 62101F | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) ERP No. 399 | |
| d. DOD SUBELEMENT 681000 | | |
| 10. DISTRIBUTION STATEMENT | | |
| Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYC) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Airborne sea surface temperature (SST) measurements made by the infrared technique are becoming more numerous, but they are of variable accuracy. The need for even more synoptic reports and for better accuracy of these reports is discussed. However, the best method to apply corrections for atmospheric induced errors is still being developed. | | |
| The various errors contributing to the total error in airborne sea surface temperature measurements are described and their magnitudes discussed. The various present methods of applying corrections to these airborne measurements to eliminate errors due to the intervening atmosphere are discussed. A detailed discussion of atmospheric cross section flights using an airborne infrared radiometer making SST measurements between altitudes of 100 to 10,000 ft above the sea while passing over a surface ship which was measuring the actual sea surface temperature is presented. Ways to improve the accuracy of airborne SST measurements are discussed. | | |
| It is strongly recommended that a single, standardized atmospheric correction procedure be adopted by all weather reconnaissance aircraft operators of our country. This would insure that all airborne synoptic SST data are compatible for analysis. KEYWORDS: Sea surface temperature measurement, Airborne infrared radiometer, Airborne meteorological parameter sensing, Infrared temperature sensing, Correction of infrared temperature sensing, PRT-5 atmospheric corrections | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (OPI) L. G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| 2b. GROUP | | |
| 3. REPORT TITLE ATMOSPHERIC ATTENUATION OF HF AND DF LASER RADIATION | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) R. A. McClatchey J. E. A. Selby | | |
| 6. REPORT DATE 23 May 1972 | | 7a. TOTAL NO. OF PAGES 141 |
| 8a. CONTRACT OR GRANT NO. | | 7b. NO. OF REFS 16 |
| b. PROJECT, TASK, WORK UNIT NOS. 7670-09-01 | | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0312 |
| c. DOD ELEMENT | | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) ERP No. 400 |
| d. DOD SUBELEMENT | | |
| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (OPI) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT With the development of HF and DF lasers having emission lines in the range from 2800 to 3700 cm ⁻¹ (HF) and 2000 to 2750 cm ⁻¹ (DF), it is of importance to establish which of the more than 100 lines can be transmitted through a variety of atmospheric paths. The spectral region of HF emission spans a very important water vapor absorption band and, in addition, there is strong absorption by CO ₂ and weaker absorption by ozone and methane. The spectral region of DF emission covers the very strong 4.3 μm CO ₂ absorption band and weaker absorption by N ₂ O and HDO at higher frequencies (low DF vibrational transitions). There is some weak ozone absorption also in the region of DF emission. Absorption lines associated with all of these molecules were included in the calculation of synthetic spectra covering the region of HF and DF emission. After limiting the number of emission lines to be considered in detail according to a criterion based on atmospheric attenuation, a series of tables was constructed providing quantitative attenuation information for each of 97 laser lines and for 10 different atmospheric models. Data based on two different aerosol scattering models are included in these tables. It is concluded that due to both atmospheric attenuation and laser emission energy, it is advantageous in general to develop laser systems using the higher vibrational transitions of the HF emission and the lower vibrational transition of the DF emission. KEYWORDS: Laser attenuation, HF laser transmittance, Atmospheric transmittance, DF laser transmittance | | |

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| (Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) | | |
| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LKA) L. G. Hanscom Field Bedford, Massachusetts 01730 | 2a. REPORT SECURITY CLASSIFICATION Unclassified | 2b. GROUP |
| 3. REPORT TITLE POLAR CAP PARTICLE INTEGRAL ENERGIES FROM N ₂ ⁺ INTENSITIES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) William N. Hall | | |
| 6. REPORT DATE 29 June 1972 | 7a. TOTAL NO. OF PAGES 20 | 7b. NO. OF REFS 11 |
| 8a. CONTRACT OR GRANT NO. | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0400 | |
| b. PROJECT, TASK, WORK UNIT NOS. 7661-04-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) ERP, No. 402 | |
| c. DOD ELEMENT 62101F | | |
| d. DOD SUBELEMENT 681000 | | |
| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Presented at National Fall Meeting, American Geophysical Union, Jack Tar Hotel, San Francisco, California, 6 to 9 December 1971. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKA) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Optical intensity measurements are shown to be effective for detecting fluxes of low energy (1 to 4 MeV) protons in the polar cap. Energies calculated from N ₂ ⁺ IN optical intensities showed close agreement with energies calculated from particle differential energy spectra for two Solar Particle Events (SPE) with markedly different energy spectra. Satellite measurements showed the 2 Nov 1969 SPE had fewer 2-MeV protons than the 7 Nov 1969 SPE but had 100 times more protons with energies greater than 10 MeV. The fact that optical emissions are produced by large fluxes of low energy protons is contrasted with riometer measurements, which have been shown to be related to fluxes of protons with energies greater than 5 to 10 MeV. Comparing times with equal energies, corresponding to equal optical intensities, the riometer absorption was 4 dB at 1500 UT on 3 Nov and 1 dB at 0600 UT on 8 Nov. | | |
| KEYWORDS: Polar cap, Solar particle event, 3914A, N ₂ ⁺ IN optical emissions, Solar particle energy spectra | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LK) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | | 2b. GROUP |
| 3. REPORT TITLE PROBABILITY OF ENCOUNTERING THUNDERSTORMS AT 50,000 AND 60,000 FT FOR SELECTED ROUTES OVER THE U.S. | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Donald D. Grantham Arthur J. Kantor | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LK) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT <p>The probability of encountering cumulonimbi has been determined for the worst route, month and time; that is, over the southern U.S. during July between 1600 and 1800 LST. Three transcontinental routes are examined: Miami to Los Angeles, Miami to San Francisco, and Washington D.C. to Los Angeles, distances measuring 2000, 2250, and 2030 nmi, respectively. Preliminary results indicated one encounter (within a 10-mile-wide flight path) for every 4 flights along the Miami-West Coast routes at 50,000 ft, and one for every 57 flights along the same routes at 60,000 ft. Clouds are assumed to be dome-shaped with base diameters ranging from 6.7 to 15 nmi at 50,000 ft and 6.7 to 10.5 nmi at 60,000 ft.</p> | | |
| KEYWORDS: Supersonic aircraft design, Stratospheric thunderstorms, Thunderstorm encounter probabilities, Thunderstorm radar detection | | |

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| 3. REPORT TITLE A MODEL OF AURORAL SUBSTORM ABSORPTION | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Terence J. Elkins | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT High-frequency radio propagation at high latitudes is strongly affected by auroral absorption, which is known to occur sporadically in events known as auroral substorms. A brief discussion of the morphology of substorms is presented, followed by an analysis of auroral absorption during 60 substorms. The statistical parameters necessary to specify a predictive model are derived empirically as a function of time after substorm onset. Also presented from other evidence are relationships to model the latitude dependence, substorm duration, frequency dependence, and the seasonal and solar cycle dependence. A brief discussion of structure size in auroral absorption events is included. | | |
| KEYWORDS: Polar ionosphere model, Auroral absorption, Riometer measurements, Auroral substorms | | |

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3. REPORT TITLE

AN OBJECTIVE BASELINE FOR FLARE PREDICTION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Ronald T. Podsiadlo

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13. ABSTRACT

The relationship between various measurable solar parameters and solar-flare occurrence is examined utilizing a comprehensive solar-geophysical data base containing a variety of objectively-correlated solar measurements. The sample covers the period from January 1955 through February 1968 and includes such parameters as solar flares, sunspots, magnetic fields of sunspots, calcium plages and 9.1 cm radio brightness temperatures. A statistical analysis was performed to determine the parameters most useful for the prediction of solar flares 24 hours in advance. Persistence was identified as the single most important flare predictor, with sunspot magnetic classification, 9.1 cm radio brightness temperature, plage brightness and sunspot area also selected as useful predictors. Objective flare probability prediction equations were developed that incorporate all useful predictors simultaneously. Further details of this work will be discussed with some comments relative to future work utilizing satellite X-ray data.

KEYWORDS: Solar flare forecasting

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| 3. REPORT TITLE ENHANCEMENT OF 0.24-0.96-MEV TRAPPED PROTONS DURING THE 25 MAY 1967 MAGNETIC STORM | | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | | |
| 5. AUTHOR(S) (First name, middle initial, last name) P. L. Rothwell L. Katz | | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PHE) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT <p>During the large 25 May 1967 magnetic storm, a solid-state detector spectrometer, aboard the polar-orbiting satellite OV1-9, measured 0.24 to 0.96 MeV protons. A nonadiabatic, semipermanent enhancement of protons was observed following the storm in the region $2.50 < L < 3.25$, $B = 0.10 + 0.02$, at $LT = 1800$ hr. The 0.265-MeV proton flux increased by about a factor of 25, while the 0.885-MeV proton flux increased by a factor of 4 to 5. This proton increase is compared with that recently reported by Burns and Krimigis (1972) for the 17 April 1965 magnetic storm and with the more common injection/acceleration of electrons during less severe magnetic storms. From these comparisons we conclude that both electron and the proton enhancements are selective both in L and energy. This suggests a magnetospheric resonance as the energy source of these enhancements. Temporal changes in the energy spectra imply that the resonance accelerates the particles by means of the E-conserving diffusion mode as defined in the work of Theodoridis et al (1969).</p> | | | |
| KEYWORDS: 25 May 1967 magnetic storm, Enhancement of trapped protons | | | |

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| 3. REPORT TITLE INVESTIGATION INTO UTILIZATION OF LORAN AND OMEGA WIND-FINDING SYSTEMS FOR MEASURING WINDS BELOW AN AIRCRAFT | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Bernard D. Weiss James F. Morrissey | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYJ) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT In response to an Air Force requirement, AFCRL (LYJ) performed a series of field tests designed to evaluate the accuracy/resolution relationship of the NAVAID systems (Loran/Omega) for measuring the vertical profile of the wind. Specifically, these tests involve a series of flight comparisons between the AN/FPS-16 radar and the Omega and Loran equipments. These comparisons were performed using balloon-borne radiosondes with the receiving and processing equipment located on the ground. The specific Air Force requirements are for an accuracy of 3 knots with a 2000 ft sensing interval and a fall rate of 1000 ft/min or greater. The Loran equipments were found to be capable of a 1.4 knot accuracy for these conditions, while the Omega equipments provided an accuracy of 4.3 knots. Since the data analyzed were obtained by tracking the Loran/Omega sonde(s) with ground-based NAVAID equipment, further investigation is currently underway to determine what effect operating in an aircraft environment will have on the system accuracy. These investigations are concentrated on Omega because of its worldwide coverage and include the development of a higher powered dropsonde coupled with the incorporation of the newest processing equipments (LO-CATE III). | | |
| KEYWORDS: Navigational aid, LORAN, OMEGA, Windfinding system | | |

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| 3. REPORT TITLE THE EXPANSION OF PHYSICAL QUANTITIES IN TERMS OF THE IRREDUCIBLE REPRESENTATIONS OF THE SCALE-EUCLIDEAN GROUP AND APPLICATIONS TO THE CONSTRUCTION OF SCALE-INVARIANT CORRELATION FUNCTIONS. PART II: THREE-DIMENSIONAL PROBLEMS: GENERALIZATIONS OF THE HELMHOLTZ VECTOR-DECOMPOSITION THEOREM | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) H. E. Moses A. F. Quesada | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKC) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT <p>The irreducible representations of the scale-Euclidean group in three dimensions are introduced, and the general tensor is expanded in terms of these representations. The cases of zero-rank tensor (scalar), rank-1 tensor (vector), and rank-2 tensor, are studied in detail. The expansion is shown to be a generalization of the Helmholtz expansion of a vector into rotational and irrotational parts.</p> <p>As in Part I of this work (Concepts: One-Dimensional Problems), the correlations that are introduced are invariant under changes of frames of reference. Correlations are set up between tensors of different ranks and dimensions. A correlation that measures a degree of isotropy is defined.</p> | | |
| KEYWORDS: Correlations, Autocorrelations, Statistics, Dimensional analysis, Three-dimensional Euclidean group, Rotation group, Helmholtz theorem | | |

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| 3. REPORT TITLE AN EXPERIMENTAL STUDY OF THE INTERACTION OF MODERATE POWER MICROWAVES WITH ELECTRON DENSITY GRADIENTS | | |
| 4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Scientific. Interim. | | |
| 5. AUTHOR(S) <i>(First name, middle initial, last name)</i> Daniel J. Jacavanco | | |
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| c. DOD ELEMENT 62101F | | 9b. OTHER REPORT NO(S) <i>(Any other numbers that may be assigned this report)</i> PSRP No. 492 |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZP) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT <p>This paper presents the results of an experiment which examines the interaction of a moderate power microwave signal with an inhomogeneous electron density gradient. The result of this interaction is a self-shielding plasma, generated by the absorption of 10 GHz microwaves, which propagates toward the energy source at a velocity which is a function of pressure, type of gas and incident heating field intensity. These results are essentially in agreement with the shock tube work of Bethke (1969) but are extended to show new and interesting effects of applying a transverse dc magnetic field to the test section. Magnetic field results suggest that heating of the electron gas occurs at the hybrid resonance frequency at magnetic fields below cyclotron, and propagation of the extraordinary mode is inhibited at low magnetic fields.</p> | | |
| KEYWORDS: Non linear microwave, Electron density gradient, Non linear plasma | | |

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| 3. REPORT TITLE USE OF PLASTIC DETECTORS TO CONFIRM THE ACCELERATION OF ARGON NUCLEI TO RELATIVISTIC VELOCITIES AT THE PRINCETON PARTICLE ACCELERATOR | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Robert C. Filz P.J. McNulty A.F. Davis | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY AF Cambridge Research Laboratories/PHE L.G. Hanscom Field Bedford, Mass. 01730 |
| 13. ABSTRACT Argon ions were recently accelerated to 11.7 GeV at the Princeton Particle Accelerator. This represents a two-fold increase in the mass over particles previously accelerated to relativistic energies. This report describes how a stack of cellulose nitrate track detectors was used to confirm the successful acceleration with the unambiguous identification of 79 argon tracks within a clearly defined 1 1/4-inch-beam spot. | | |
| KEYWORDS: Nuclear particle detectors, Nuclear particle accelerator, Plastic detectors | | |

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| 3. REPORT TITLE INTENSITY OF SCATTERED LIGHT FROM LARGE DIAMETER INFINITE ICE CYLINDERS IN THE NORMAL PLANE |
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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. |
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| 5. AUTHOR(S) (First name, middle initial, last name) Richard E. Bird |
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| 13. ABSTRACT An efficient and numerically stable method for calculating the intensity of light scattered from large diameter infinite cylinders with complex indices of refraction is presented. The method is applicable to both oblique and normal incidence; however, only normal incidence is considered in detail here. A comparison is made between this exact theory and approximate methods derived from geometrical optics and diffraction theory. Both Kirchoff and Keller diffraction theories are considered, and the region of the rainbow is discussed in some detail. Results from cylinders with size parameters of 15, 100, 400 and 800 are presented. |
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KEYWORDS: Ice, Light scattering, Infinite cylinders, Diffraction, Geometrical optics

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LQ) L. G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE HIGH FLUX ELECTRON IRRADIATIONS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) L.O. Bouthillette L.F. Lowe | | |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LQ) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT Experimental techniques were developed for achieving high flux, high energy (1.5 MeV) electron irradiations in conjunction with radiation effects studies. Using these techniques a system was designed and fabricated which allowed irradiations to be carried out at a flux of $4 \times 10^{14} e^- cm^{-2} sec^{-1}$ on a routine basis. These flux levels allowed fluences of $10^{19} e^- cm^{-2}$ to be achieved in a one-day irradiation. | | |
| KEYWORDS: Radiation effects, Electron accelerator, Beam monitoring, Beam handling | | |

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| 3. REPORT TITLE SOME ASPECTS OF THE OPTICAL EVALUATION OF CO ₂ LASER WINDOW MATERIALS AT AFCRL | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Bernard Bendow, Herbert G. Lipson Audun Hordvik, Lyn Skolnik | | |
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| 11. SUPPLEMENTARY NOTES Presented at the Fifth DoD Conference on Laser Technology, Monterey, Calif., April, 1972, under the title "Optical Evaluation of CO ₂ Laser Window Materials" | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LQO) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT An overview of some of the theoretical and experimental aspects of the AFCRL optical evaluation program for high-power laser window materials is presented. A vector diffraction theory used to treat the thermal lensing problem is described. Absorption coefficient measurements on state-of-the-art window materials are presented, and problems encountered in optical evaluation by calorimetry are discussed. A new interferometric technique for measuring absorption coefficients of low optical loss materials is described. | | |
| KEYWORDS: Laser window materials, Infrared optics, Diffraction optics, Thermal lensing, Interferometry, Calorimetry | | |

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3. REPORT TITLE

MICROSTRIP PLASMA PROBE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Nicholas V. Karas

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13. ABSTRACT

This report describes a new diagnostic tool—the microstrip plasma probe—which can be used in the laboratory or in a flight payload with little modification. It is rugged in construction, simple in geometric shape, small in frequency operation and low in power requirements.

Since the probe is flush mounted and nonradiating, its analytic capability depends on the modification of its electric fringing fields by the outside medium. A measure of standard parameters—that is, reflection coefficient and insertion loss of the probe—can be related back through a series of equations to the parameters of the disturbing medium.

Two general models are presented; one with a lossless center conductor, and one with a lossy center conductor. Where possible, theory and experiment are compared. The results are close. A calibration procedure for both models is described.

KEYWORDS: Plasma, Reentry analysis, Rocket

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MULTIPLEX TECHNIQUES IN SPECTROSCOPY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

George A. Vanasse

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Invited paper presented at the Spring 1972 Meeting of the Optical Society of America in New York City

12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research Laboratories (OP)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This report is an extended version of an invited paper presented at the 1972 Spring meeting of the Optical Society of America held in New York City. The report compares spectrometric systems from the point of view of efficiency. Three important properties of a spectrometer are: (1) its throughput, (2) whether or not it is a multiplex system, and (3) its free spectral range. Various multiplex systems are described, and an attempt is made to present a comparison of the merits of implementations of such systems. Systems considered are the Michelson and Lamellar-grating interferometers, the Mock interferometer, and the Hadamard transform spectrometer.

KEYWORDS: Multiplex, Spectroscopy, Fourier, Interferometry

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| 4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Scientific. Interim. | | |
| 5. AUTHOR(S) <i>(First name, middle initial, last name)</i> H. Posen A. Armington J. Bruce | | |
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| 13. ABSTRACT The criteria for the selection of alkali halides as high power 10.6 μ m laser window materials are discussed. Experiments for improving the mechanical properties of these materials, such as hardening, hot forging and alloying are described. Also a discussion of the damage mechanism in KC1 is given. | | |
| KEY WORDS: High-power laser window material, Alkali Halides, Strengthening mechanisms, Phase diagram, X-ray topography, Thermal conductivity | | |

Special Reports

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| <p>KEYWORDS: Magnetometer, Neutron monitor, ELF noise, Riometer, Solar optical observations, Solar radio emission, Vertical incidence ionospheric soundings</p> | | | | | | | | |

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3. REPORT TITLE

SEASONAL, DIURNAL AND MAGNETIC DEPENDENCE OF IONOSPHERIC SCINTILLATION AT 64° INVARIANT LATITUDE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

J. Aarons
J. P. Mullen
H. E. Whitney

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13. ABSTRACT

F layer irregularities at the invariant latitude of 64° were studied by observing amplitude scintillations at 137 MHz of the synchronous satellite, ATS-3; observations were made from Narssarssuaq, Greenland. In the 2 yr of data analyzed (1968-1970) consistent seasonal effects were noted. Quiet day winter records showed little diurnal variation. Quiet day summer daytime values showed extremely low occurrence of scintillation. These seasonal patterns must now be integrated into the model of the high latitude irregularity region. The occurrence of high amplitude fluctuations correlated sensitively with the magnetic index. Nightly means of scintillation index showed a positive correlation of 0.46 with night means of K_p. The autocorrelation function of the nightly scintillation index reveals that a long time constant of several days exists for the irregularity pattern. During magnetic storms the time of maximum occurrence of scintillation shifts from the quiet day peak of 2200 to a peak between 0300 and 0500 when K_p=4-9. The morphology of the irregularity region is becoming more evident with the addition of the seasonal pattern and the long term consistency of the irregularities.

KEY WORDS: Ionospheric scintillation, Auroral oval scintillations, VHF

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| 13. ABSTRACT Using photoelectric methods we have repeated Plaskett's (1970) measurements of pole-equator temperature differences. We average many limb-darkening scans to reduce statistical errors. We then analyze the differences between the average polar and equatorial scans. Plaskett's large pole-equator temperature differences are not confirmed. Our data yield a pole-equator temperature difference of $1.5K \pm 0.6K$, although we cannot rule out systematic errors of 3-4K. | | |
| KEYWORDS: Solar photosphere, Pole-equator temperature difference | | |

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| 3. REPORT TITLE INTERPRETATION OF INFRARED OXYGEN SPECTROHELIOPHOTOGRAMS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Richard C. Altrock | | |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
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| 13. ABSTRACT Spectroheliograms have been obtained in the line cores of two infrared multiplets of neutral oxygen. Those made in the lines of the 7770 Å multiplet show a very smooth intensity distribution, with faculae and sunspot penumbras at a very low contrast with respect to the undisturbed photosphere. Spectroheliograms made in the core of λ8446.37 Å show evidence of coupling with chromospheric features and of blending with a line of neutral iron. An analysis of a λ7772 Å spectroheliogram indicates that a magnetic field of approximately 1500 G is required to produce the 'disappearing penumbra' phenomenon. This value is consistent with the recent observations of Beckers and Schröter (1969). | | |
| KEYWORDS: Spectroheliogram, Solar chromosphere, Solar spectra | | |

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3. REPORT TITLE

SOURCE FUNCTIONS OF INFRARED FRAUNHOFER LINES FROM EQUIVALENT WIDTHS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Richard C. Altrock

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13. ABSTRACT

A method for obtaining the source function and value of $r_0 \equiv k_C/k_{L,0}$ from the variation of equivalent width across the solar disk has been applied to several infrared Fraunhofer lines. The results indicate that most of the lines investigated have non-L.T.E. source functions which are less than or equal to the mean continuum intensity. DeJager and Neven (1968) appear to have underestimated the departures from L.T.E. in a number of cases.

KEYWORDS: Source function, Fraunhofer lines, Solar atmosphere

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| 3. REPORT TITLE ACHROMATIC LINEAR RETARDERS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) J.M. Beckers | | |
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| 13. ABSTRACT A method is described to increase the thicknesses of achromatic linear retarder elements without sacrificing the angular aperture by making each of the elements out of a combination of two thicker pieces. | | |
| KEYWORDS: Achromatic wave plates, Linear retarders, Optical filters | | |

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3. REPORT TITLE

ACHROMATIC LINEAR RETARDERS WITH INCREASED ANGULAR APERTURE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

J. M. Beckers

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12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research
Laboratories (LM)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Various combinations of waveplates are identified whose degree of achromatism is dependent on the dispersions of birefringence and on the thickness of the individual waveplates. The advantages of these combinations of waveplates over others are described.

KEYWORDS: Birefringence, Retarders, Wave plates, Achromatic waveplates,
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3. REPORT TITLE

NARROW BAND FILTERS BASED ON MAGNETOOPTICAL EFFECTS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)

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13. ABSTRACT

The theory is developed for two types of narrow band filters. One is based on the Zeeman splitting of the line absorption coefficient; the other is based on the splitting of the anomalous dispersion curves in a Zeeman multiplet. The latter type filter is very similar to the Lyot-Öhman filter. It uses however the Macaluso-Corbino effect instead of the linear birefringence of crystals. It is capable of giving very much narrower transmission profiles than the Lyot-Öhman filter and it has a very wide field.

KEYWORDS: Magneto-optical, Narrow band filters, Solar observing

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| 3. REPORT TITLE THE PROFILES OF FRAUNHOFER LINES IN THE PRESENCE OF ZEEMAN SPLITTING II:Zeeman Multiplets for Dipole and Quadrupole Radiation |
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| 13. ABSTRACT |
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The radiative transfer equations (LTE) in the four Stokes parameters are derived for the general case of a Zeeman multiplet for both electric and magnetic dipole as well as for electric quadrupole radiation.

KEYWORDS: Fraunhofer liner, Zeeman splitting, Solar atmosphere

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3. REPORT TITLE

THE INTENSITY, VELOCITY AND MAGNETIC STRUCTURE OF A SUNSPOT REGION III: On the Origin of the Apparent π Component in Sunspot Umbrae

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)

J. M. Beckers
E. H. Schroter

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| 11. SUPPLEMENTARY NOTES Reprinted from Solar Physics 7 (1969) 22-25. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT

The appearance of the π component of a normal Zeeman triplet in sunspot umbrae is discussed. The effect of saturation on the shape of the spectral line profile is investigated as a factor in explaining the anomalous behavior of the umbral π component.

KEYWORDS: Sunspot umbrae, Solar magnetic fields, Zeeman triplet

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| 3. REPORT TITLE THE INTENSITY, VELOCITY AND MAGNETIC STRUCTURE OF A SUNSPOT REGION IV:Properties of a Unipolar Sunspot | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) J.M. Beckers E.H. Schröter | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Solar Physics 10 (1969) 384-403. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT From an investigation of spectra in a magnetically sensitive ($\lambda 6173$, $g=2.5$) and insensitive line ($\lambda 5576$, $g=0$), we derived the following properties for a symmetrical sunspot: (a) The magnetic field strength varies with the distance ρ ($\rho \leq 1$) from the sunspot center like $H(\rho) = H(0) (1+\rho^2)^{-1}$. (b) The zenith angle of the magnetic field varies like 90° . From this and from $H(\rho)$ we find a height gradient of 0.5 gs/km at $\rho=0$. (c) The equivalent width and the half width of $\lambda 5576$ show an increase in penumbral regions of maximum Evershed flow. Most likely this is due to a combination of inhomogeneities in the Evershed flow and "microturbulence." (d) We find the magnetic field strength to be larger in the dark interfilamentary regions of the penumbra. These regions move downwards with respect to the bright filaments and probably have a more horizontal magnetic field. (e) In a weak light bridge and in extensions of bright penumbral filaments into the umbra, we find a decrease of the magnetic field strength, and a more horizontal field direction with respect to the umbral surrounding. (f) In umbral dots and in the light bridge we find a relative upward motion. | | |
| KEYWORDS: Sunspot, Solar magnetism, Unipolar sunspot | | |

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| 3. REPORT TITLE SOLAR MAGNETIC FIELD MEASUREMENTS USING BABINET COMPENSATORS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) J.M. Beckers J.O. Stenflo | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Solar Physics 6 (1969) 480-481. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The use of a Babinet compensator to measure solar magnetic fields by means of the fringe pattern produced in a spectroheliogram is described | | |
| KEYWORDS: Solar magnetic fields, Babinet compensator, Spectroheliograph | | |

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| 3. REPORT TITLE CHROMOSPHERIC INHOMOGENEITIES IN SUNSPOT UMBRAE |
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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. |
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| 5. AUTHOR(S) (First name, middle initial, last name) Jacques M. Beckers Paul E. Tallant |
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13. ABSTRACT

The properties of rapidly changing inhomogeneities visible in the H and K lines above sunspot umbrae are described. We find as properties for these 'Umbral Flashes':

- (a) A lifetime of 50 sec. The light curve is asymmetrical, the increase is faster than the decrease in brightness.
- (b) A diameter ranging from the resolution limit up to 2000 km.
- (c) A tendency to repeat every 145 sec.
- (d) A 'proper motion' of 40 km/sec generally directed towards the penumbra.
- (e) A Doppler shift of 6 km/sec.
- (f) A magnetic field of 2100 G.
- (g) A decrease in this field of 12 G/sec. This decrease is probably related to the flash motion.
- (h) At any instant an average of 3-5 flashes in a medium-size umbra. A weak feature often persists in the umbra after the flash. This post-flash structure initially shows a blue shift, but 100-120 sec after the flash, it shows a rapid red shift just before the flash repeats.

KEYWORDS: Solar sunspot umbrae, Solar chromosphere, Solar inhomogeneities

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3. REPORT TITLE

A PHOTOGRAPHIC POLARIMETER FOR SOLAR OBSERVATIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

J.M. Beckers
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11. SUPPLEMENTARY NOTES

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12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research
Laboratories (LM)
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Bedford, Massachusetts 01730

13. ABSTRACT

The photographic polarimeter used to measure the linear polarization of solar coronal and prominence emission lines at the 7 March 1970 solar eclipse is described.

KEYWORDS: Solar corona, Solar prominence, Photographic polarimeter,

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| | | 2b. GROUP |
| 3. REPORT TITLE A COMPARISON BETWEEN TOTAL OZONE AS MEASURED BY NIMBUS 3 AND THAT COMPUTED FROM A NUMERICAL MODEL | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific, Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) L.Berkofsky S.Gyoeri | | |
| 6. REPORT DATE 29 August 1972 | 7a. TOTAL NO. OF PAGES 6 | 7b. NO. OF REFS 6 |
| 8a. CONTRACT OR GRANT NO. | 8a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0488 | |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from Space Research XII, Akademie-Verlag, Berlin 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYD) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Instruments aboard Nimbus 3 measured total ozone contents over the globe for two eight-day periods during April and July 1969. The zonally averaged eight day mean profiles show latitudinal distributions similar to those obtained from earlier measurements. Using a zonally averaged model of the atmosphere including photochemical effects, numerical integrations have been carried out for periods of one year, starting with the autumnal equinox. The model reproduces the Nimbus 3 observations reasonably well, provided eddy diffusion is included as a transport process. | | |
| KEY WORDS: Ozone, Nimbus 3, Numerical model | | |

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| 3. REPORT TITLE FLARE-ASSOCIATED CORONAL EXPANSION PHENOMENA | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Anton Bruzek Howard L. Demastus | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Solar Physics 12 (1970) 447-457. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT <p>Two classes of coronal expansion phenomena have been studied in Sacramento Peak coronal movies: Slow, slightly decelerated expansion phenomena ($v \sim 10 - \sim 2$ km/sec) and fast, accelerated, quasi-exploding arches ($v \sim 10 - > 100$ km/sec). The various phenomena were found to be associated with flares in different ways: The slow expansions were long lived post-flare phenomena initiated by the flare; the accelerated expanding arches were either (a) arches expanding prior to and apparently exploding at flare onset, or (b) arches apparently emerging from the flare (probably in its initial phase) and rapidly expanding and exploding, or (c) the expansion and disruption of (originally stable) coronal arches during occurrence of a distant flare. These expansions may be considered as evidence for corresponding flare associated changes in the coronal magnetic field.</p> | | |
| KEYWORDS: Solar flares, Solar corona, Active regions | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LZM) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE THE EFFECT OF TEMPERATURE AND DOPPLER SHIFT ON THE PERFORMANCE OF ELASTIC SURFACE WAVE ENCODERS AND DECODERS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific, Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Paul H. Carr Peter A. DeVito Thomas L. Szabo | | |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from IEEE Transactions on Sonics and Ultrasonics, Vol. SU-19, No. 3, July 1972, pp. 357-367. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZM) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT An experimental and theoretical study has been made of the effect of temperature differences and Doppler shifts on the performance of surface wave encoders and decoders. A 31-bit bi-phase modulated maximal length sequence was generated at a center frequency of 70 MHz on a slab of YX quartz and decoded or correlated on a similar slab. The taps were spaced 0.1 μ sec apart. The peak-to-maximum-sidelobe ratio degraded by 3 dB when the temperature difference between encoder and decoder was 82°C. The corresponding Doppler width of 240 kHz was observed, both measurements being in good agreement with theoretical predictions. Similar devices were fabricated on YZ lithium niobate. Although the insertion loss was much less than on quartz, the peak-to-sidelobe ratio degraded by 3 dB in 23°C. The use of a frequency offset was used to compensate for and remove the degradation of the peak-to-sidelobe ratio due to a temperature difference. The temperature dependence of the peak-to-maximum-sidelobe ratio has been calculated for a number of different binary sequences up to 127 bits long. Sequences with high peak-to-sidelobe ratios for no temperature differences were more temperature dependent than those with lower peak-to-sidelobe ratios. Data is given for the selection of the optimum sequence and material for a given application. | | |
| KEYWORDS: Surface waves, Encoders and decoders, Effect of temperature on surface waves | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LWG) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE OPERATIONAL TESTS OF THE AFCRL 152-cm TELESCOPE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) William E. Carter | | |
| 6. REPORT DATE 21 August 1972 | | 7a. TOTAL NO. OF PAGES 1 |
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| b. PROJECT, TASK, WORK UNIT NOS. 8607-03-01 | | 9a. ORIGINATOR'S REPORT NUMBER(S) AFCRL-72-0484 |
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| 11. SUPPLEMENTARY NOTES Reprinted from Applied Optics, Vol. 11, p. 1651, July 1972. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LWG) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT Initial tests of the AFCRL 152-cm composite Cer-Vit-Steel reflecting telescope indicate that the resolution and temperature operating range of the telescope are excellent. Observers have been able to resolve lunar features of less than one kilometer breadth; the resolution has been checked by observations of double stars and Saturn's rings. Temperature changes of 20-30°C are tolerated by the mirror without significant distortion of the figured surface. | | |
| KEYWORDS: Lunar laser ranging, Optical offsetting, Offset tracking | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | | 2b. GROUP |
| 3. REPORT TITLE THE PROPERTIES OF THE NEUTRAL ATMOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) K.S.W. Champion | | |
| 6. REPORT DATE 28 August 1972 | 7a. TOTAL NO. OF PAGES 35 | 7b. NO. OF REFS 69 |
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| 11. SUPPLEMENTARY NOTES Reprinted from Space Research XII, Akademie-Verlag, Berlin 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT This review is concerned with the physical properties of the neutral upper atmosphere above 25 km, that is of the stratosphere, mesosphere and exosphere. Experimental results are included from measurements with rockets, satellites and ground-based radars and optical instruments. Many new data are available, partly from low altitude satellites, for density and winds during disturbed conditions associated with geomagnetic storms. Progress has been made in representing the semi-annual effect in terms of variations in density. Due to new data temperature changes during disturbed conditions can be represented more accurately. The radar incoherent scatter and optical Doppler broadening techniques have been increasingly used to provide temperature results. In composition the absolute values of O and O ₂ densities in the lower thermosphere are still being actively debated. In an auroral arc NO density at 120 km in excess of that of O ₂ has been observed. In model atmospheres the low altitude, high altitude and mean CIRA 1971 models are being presented. | | |
| KEY WORDS: Neutral atmosphere, Density, Winds, Temperature, Composition | | |

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| 3. REPORT TITLE MODELS OF EXTREME ARCTIC AND SUBARCTIC WINTER ATMOSPHERES BETWEEN 20 AND 90 KM | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific, Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) A.E. Cole | | |
| 6. REPORT DATE 29 August 1972 | | 7a. TOTAL NO. OF PAGES 8 |
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| 11. SUPPLEMENTARY NOTES Reprinted from Space Research XII, Akademie-Verlag, Berlin, 1972. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKI) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT Rocket observations have been used to construct a set of atmospheric models from 20 to 90 km that represent the vertical distributions of thermodynamic properties associated with the extreme cold and warm stratospheric and mesospheric regimes that occur in arctic and subarctic regions during the winter months. There are strong positive correlations between temperatures at levels between 30 and 55 km during both regimes. Temperatures at lower and higher levels, however, are negatively correlated with those between 30 and 55 km. The negative relationships are compensating features which prevent unlimited variations in horizontal gradients of pressure and density and associated wind fields. Models for warm and cold regimes which have a 5 and 10 % likelihood of being equalled or exceeded at Churchill, Canada (59° N) during December and January are presented. Frequencies of occurrence of these warm and cold regimes are also given for Ft. Greely, Alaska (64° N) and West Geirinish, Scotland (57° N). KEYWORDS: Stratosphere, Mesosphere, Density, Pressure, Temperature | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LYC) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE A WARM CUMULUS MODIFICATION EXPERIMENT | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Robert M. Cunningham Morton Glass | | |
| 6. REPORT DATE 26 July 1972 | | 7a. TOTAL NO. OF PAGES 4 |
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| b. PROJECT, TASK, WORK UNIT NOS. 7605-04-01 | | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) |
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| 13. ABSTRACT <p style="margin-left: 20px;">A warm cloud modification experiment was conducted off the east coast of Florida during September 1971 to test the use of encapsulated urea as a seeding agent for triggering rain or increasing rainfall amounts in warm cumulus clouds. The seeding and measurement program consisted of selecting, over the course of each daily flight, two to six clouds of similar dimensions. Half the clouds were seeded, half were controls. The order of selection was on a random basis. Knowledge as to which cloud was seeded and which was not, was not made available to the authors until the analysis was nearly complete. Three aircraft were used in the project. A C-130 for seeding and subsequent measurement of internal cloud properties, a Piper Aztec for measurement of cloud base parameters and rainfall, and a high flying RB-57F for photographing the target clouds and the surrounding mesoscale cloud system. Some 26 clouds were selected on 7 days over a 2-1/2 week period. The RB-57F made 136 photo passes, the C-130 111 cloud passes, and the Aztec 270 below cloud rain passes.</p> <p style="margin-left: 20px;">An analysis of all clouds penetrated was done in order to determine initial cloud conditions so that a reasonably uniform experimental cloud population could be selected. The subsequent history of each cloud in terms of its growth, liquid water content, and buoyancy changes was determined so that results of seeding could be sought in the differences observed.</p> | | |
| KEYWORDS: Warm cloud seeding, Aircraft cloud measurements, Precipitation, Capsulated area, Cloud physics, Weather modification | | |

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WALSH FUNCTIONS IN GRILLE SPECTROSCOPY

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George A. Vanasse

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Reprinted from Proceedings on Application of Walsh Functions, March 1972, Catholic University of America, Washington, D.C.

12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research Laboratories (OPI)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Walsh Functions have been very useful in transform spectroscopy as evidenced by the recent work in Hadamard transform spectroscopy. It is also possible to use Walsh functions to generate a suitable grille for use in grille spectroscopy as developed by Girard. The hyperbolic grill that is often used in this technique is very closely related to the grill whose transmittance is defined by a complete set of the sal functions. This paper explores this relationship and indicates how other grilles of specified properties may be generated. Thus, the application of Walsh functions can be profitably extended to the domain of the grille spectrometer.

KEYWORDS: Multiplex spectroscopy, Hadamard functions

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| 3. REPORT TITLE THE MAGNETIC FIELD AS A MECHANISM TO PRESERVE RELATIVISTIC MOMENTUM | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Edmond M. Dewan | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from AJP Volume 40, May 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LR) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT A thought-experimental approach is given to the definition of the magnetic field as a force arising from the need to conserve relativistic momentum. Mechanical and electromagnetic analogies are compared to illustrate the mechanisms of momentum transfer from field or stress energy to kinetic energy of a particle. | | |
| KEYWORDS; Electromagnetic momentum, Special relativity, Electromagnetism, Field momentum, Theoretical physics | | |

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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Priscilla P. Dudley Robert E. Riecker | | |
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| 13. ABSTRACT Paper discusses a Geological Society of America Penrose Conference, which convened at the Mountain Chalet, Snowmass-at-Aspen, Colorado, from 26 to 30 September 1971, fostered communication among rock mechanics experimentalists, dislocation theorists, earthquake engineers and seismologists. Eighty-four experts heard 40 short papers in informal sessions on friction, pore pressure, microearthquakes, source mechanisms, and crustal deformation. | | |
| KEYWORDS: Earthquakes, Source mechanisms, Friction, Pore pressure | | |

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| 3. REPORT TITLE SACRAMENTO PEAK'S NEW SOLAR TELESCOPE | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) Richard B. Dunn | | |
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| 13. ABSTRACT The design, construction and instrumentation of the Sacramento Peak Observatory Vacuum Tower Telescope is described in this article. | | |
| KEYWORDS: Solar telescope, Tower telescope, Vacuum telescope | | |

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| 3. REPORT TITLE 8. CORONAL EVENTS OBSERVED IN 5303 Å | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Richard B. Dunn | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from the Physics of the Solar Corona, 114-129. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT The observational and interpretational problems associated with photographing the solar corona in the wavelength 5303 Å are discussed. The events in the corona are discussed within three broad categories, (1) Slow, (2) Loops and Arches and (3) Fast Events. A classification scheme for coronal events is proposed. | | |
| KEYWORDS: Solar corona, Coronal active centers, Solar atmosphere | | |

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SACRAMENTO PEAK MAGNETOGRAPH

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L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

The Sac Peak magnetograph (DZA) has been modified from Evans' original scheme so that it measures the displacement of the right and left hand circularly polarized lines separately. The computer reduction calculates the Zeeman and radial velocity signals. A grating servo system has been added to correct for slow temperature drifts in the spectrograph. A paper-tape reader controls the raster scan and the formatting of data on to magnetic tape.

KEYWORDS: Solar instrumentation, Magnetograph

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POWER SPECTRA OF H_α DOPPLER SHIFTS

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5. AUTHOR(S) (First name, middle initial, last name)

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13. ABSTRACT

The temporal characteristics of the chromospheric velocity field in a quiet region are studied by means of a carefully guided sequence of 215 H_α spectra of the disk centre lasting 54 min. The Doppler shifts of each frame at $\Delta\lambda=0.4\text{ Å}$ are measured and the velocity history of each position on the sun is reconstructed. The velocity power spectrum is found for each of 256 points along the total slit length of 280 000 km.

A steady downward velocity is associated with places where the amplitude of the fluctuating velocity is high. The average velocity power spectrum exhibits three main features: (1) A peak at 287 sec, (2) A group of high frequency peaks in the range 150-210 sec, and (3) A low frequency peak with a period of 900 sec.

The relationship of these features to the Ca K network is discussed.

KEYWORDS: Solar chromosphere, Solar velocity fields, Solar granulation

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1. INTRODUCTION TO RESEARCH ON THE SOLAR CORONA

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5. AUTHOR(S) (First name, middle initial, last name)

John W. Evans

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L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

This lecture is an introduction to the solar corona for investigators in other solar fields. The development of our knowledge of the corona reached a turning point in 1940 with the identification of the lines of the spectrum as those of highly ionized atoms which could exist only at temperatures in the million degree range. The modern history and the details of our present knowledge begin with this and are pursued to the 1970 period. It covers the physical state of the corona and its interaction with magnetic fields, the origin and nature of the solar wind, and the problems of the heating and maintenance of mass in the corona against the known losses.

KEYWORDS: Solar corona, Solar wind, Radio astronomy, Space astronomy

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| 3. REPORT TITLE ON THE EXTREMAL NATURE OF MOLECULAR VIBRATIONAL FORCE CONSTANT SOLUTIONS WITH A SINGULAR JACOBIAN | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
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| 13. ABSTRACT The singularity of the jacobian, recently claimed by Gans to result in the extremal property that infinite values be taken by the partial derivatives of all the diagonal force constants with respect to any given off-diagonal force constant, is shown to be consistent with finite values of all the partial derivatives if the rank of the singular jacobian satisfies a specified additional condition. | | |
| KEYWORDS: Molecular, Vibrational, Force, Constant | | |

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| 3. REPORT TITLE ON THE FLUORESCENCE OF INDOLE COMPOUNDS INDUCED BY KETONE-SENSITIZED PHOTOREACTIONS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) E. Fujimori | | |
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| 13. ABSTRACT <p>When anaerobic aqueous solutions containing tryptophan and acetone are exposed to 310 nm irradiation, a new shoulder in absorbance appears at about 350 nm. Excitation of this irradiated solution with 350 nm light exhibits a new blue fluorescence at 465 nm. Indole and indoleacetic acid produce similar fluorescence though the solubility of fluorescent products in 25% acetone-water mixture depends upon the type of indoles. Biacetyl acts in a similar way as does acetone. The phosphorescence of biacetyl is quenched efficiently by various indoles: indoleacetic acid tryptamine tryptophan indole indolealdehyde. The primary photochemical step probably consists of an electrophilic attack on the indole-ring by the triplet state of acetone or biacetyl.</p> | | |
| KEYWORDS: Fluorescence, Phosphorescence, Indole compounds, Acetone, Biacetyl, Photoreaction | | |

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| 3. REPORT TITLE IONOSPHERE (in part) | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) George J. Gassmann | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from 1972 McGraw Hill Yearbook of Science and Technology | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LIB) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT The article discusses and reviews recent results which have allowed improved mapping of the arctic and antarctic ionospheres. This invited contribution comprises one section of a two-section chapter on the ionosphere, the other section being written by W.F. Utlaut of the Institute of Telecommunication Sciences, Boulder, Colorado. | | |
| KEYWORDS: Aurora, Ionosphere, Polar, Arctic | | |

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| 3. REPORT TITLE ANALYSIS OF SIMULTANEOUS POLAR FOX II BACKSCATTER AND IONOSPHERIC SOUNDING DATA | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) G.J. Gassmann J. Buchau | | |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Presented on 3 May 1972 at Naval Postgraduate School, Monterey, Calif. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LIB) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT Backscatter data from the northward-looking POLAR FOX II radar were simultaneously taken with airborne and ground-based ionospheric soundings and optical data supplemented by satellite observations. The detailed ionization contour lines in the region from 0 to 2000 km north of POLAR FOX II, obtained for a period of about 2 hours before local midnight in December, explain why only a small range section of ground could be seen during this period. Aspect-sensitive direct backscatter echoes from field-aligned laminae both in the E- and F-layer were dominant and were found to be reflected from latitudes where vertical soundings show spread-E and -F. Those regions appear to be identical to the auroral E (night E) layer and "plasma ring" F layer known to be associated with the auroral oval. | | |
| KEYWORDS: Arctic ionosphere, Radio aurora, Auroral clutter | | |

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| 3. REPORT TITLE A SQUARE EQUAL-AREA MAP OF THE WORLD | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Irving I. Gringorten | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Journal of Applied Meteorology, Vol. 11, No. 5, August 1972, pp. 763-767. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKI) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT The map is proposed for worldwide climatological statistics, to depict accurately the area covered by some specified meteorological condition or element. Since it is square, a grid overlay divides the map into small squares, each covering exactly the same amount of global area. The map is centered on the north pole where it is conformal. The parallels of latitude in each of the four quadrants of the square are represented by elliptical arcs that change from circular shape at either pole to a straight line at the equator. Except for Antarctica no continent is split or divided in this projection. The Northern Hemisphere is presented without interruptions or discontinuities of direction. The map's four quadrants can be reassembled to place the south pole and the whole of Antarctica at the center of the representation, as an interim step in the drawing of isopleths in the Southern Hemisphere. | | |
| KEYWORDS: Equal area, Map porjection, Climatological statistics, World area | | |

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| 3. REPORT TITLE ELECTROSTATIC PROBE MEASUREMENTS OF FLOW FIELD CHARACTERISTICS OF A BLUNT BODY REENTRY VEHICLE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Dallas T. Hayes | | |
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| 13. ABSTRACT The electron density measured by four flush mounted electrostatic probes during the high altitude rapid buildup range (270 to 200 kft.) of reentry is compared with predictions assuming a completely viscous layer behind the shock in the stagnation region matched to a standard boundary layer inviscid flow field back along the body. The probes were biased at high positive or negative potentials to collect the full random current at the edge of the collision dominated sheath. Excellent agreement between probe data and prediction is obtained in the stagnation region of the vehicle. Probe data from the conical afterbody is in agreement with independent microwave data obtained for the same flight. However, both these data indicate electron densities which are greater than the predicted values by as much as an order of magnitude. Possible reasons for this discrepancy are given. | | |
| KEYWORDS: Reentry flight test, Electrostatic probe measurements of ionized flow field characteristics, Flow field prediction models | | |

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3. REPORT TITLE

THE INTERPRETATION OF XUV ROCKET MEASUREMENTS OF INTENSITY RATIOS OF SOLAR SPECTRAL LINES OF THE LITHIUMLIKE IONS OVI, NeVIII, AND MgX

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

L.Heroux
M. Cohen
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Air Force Cambridge Research
Laboratories (LKO)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

A rocket borne spectrometer was flown to measure absolute intensities of extreme ultraviolet spectral lines from the three ions OVI, NeVIII, and MgX present in the Sun. From these measurements, intensity ratios of lines from OVI, ratios of lines from NeVIII, and ratios of lines from MgX were compared with ratios calculated by using specific theoretical values of the ionization equilibrium in which dielectronic recombination was included in the processes establishing ionization balance. The effects of the electron density and temperature gradient on the temperature distribution of the flux of the spectral lines in the solar atmosphere have been taken into account in the calculations of the ratios. The agreement between the experimental and calculated ratios is good for the ions NeVIII and MgX and satisfactory for the ion OVI for which the calculated ratio is subject to large uncertainties. A reliable measurement of the electron temperature in the lower corona was obtained from the experimental ratios for MgX. This experimental temperature is in good agreement with the emission temperature of the spectral lines of MgX predicted from the theoretical values of the ionization equilibrium. The design and photometric calibration of a new rocket spectrometer developed to measure the intensity ratios over the broad spectral region 50 to 1250 Å are also described.

KEYWORDS: Solar extreme ultraviolet, Solar physics, Electron temperatures, Lithiumlike ions, Ionization equilibria

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3. REPORT TITLE

VISIBLE AND NEAR-INFRARED SPECTRA OF MINERALS AND ROCKS:
III. OXIDES AND HYDROXIDES

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)

Graham R. Hunt
John W. Salisbury
Charles J. Lenhoff

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12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research
Laboratories (LWL)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Visible and near-infrared spectra of various oxide and hydroxide minerals are presented, together with explanations of spectral features. It is shown that the principal bands are due to electronic processes in the cation or impurity ions, or to vibrational processes in hydroxyl groups or molecular water. Of the cations, iron is the most common source of electronic features, either as the principal constituent or as an impurity. Other features are produced by chromium, copper and titanium ions.

KEYWORDS: Visible, Near-infrared, Reflection spectra, Minerals and rocks spectra

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| 3. REPORT TITLE THE AFCRL LUNAR LASER RANGING EXPERIMENT IN ARIZONA | | |
| 4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Scientific. Interim. | | |
| 5. AUTHOR(S) <i>(First name, middle initial, last name)</i> Mahlon S. Hunt | | |
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| 13. ABSTRACT The AFCRL lunar laser ranging experiment is conducted from the 9100 foot peak of Mt. Lemmon near Tucson, Arizona. The ranging signal is provided by a ruby laser which can fire three joule pulses of three nanoseconds duration every five seconds. A 60 inch Cassegrain telescope of unique design is used to collimate the outgoing laser pulses and to collect the retroreflected returns. The 2-1/2 second round trip of the pulses is measured with a one-nanosecond interval counter. Tracking is accomplished with automatic offset guiding by an image-dissector tube. | | |
| KEYWORDS: Lunar ranging, Laser ranging, Telescopes | | |

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| 3. REPORT TITLE FURTHER COMMENTS ON THE CHEMILUMINESCENT REACTION $N + O_2 \rightarrow NO + O$ AND ITS OVERTONE PHOTON EFFICIENCY | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) F. Hushfar J. W. Rogers A. T. Stair, Jr. | | |
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| 13. ABSTRACT <p>The low resolution spectra of the overtone vibration-rotation band of NO formed in the reaction $N + O_2 \rightarrow NO + O$ followed by $N + NO \rightarrow N_2 + O$, is further analyzed to obtain a photon efficiency for the reaction $N + O_2$. Using the experimental results of 1.5×10^{-6} photons per second per O_2 molecule, a 5000K Boltzman distribution in the vibrational levels of NO molecule, and the rate constants k_1 and k_2 for the two reactions; the photon efficiency is calculated to be $0.06 \times 10^{-6} k_2/k_1$.</p> | | |
| KEYWORDS: Photon efficiency, Chemical reactions | | |

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| 3. REPORT TITLE SPECTRAL CHARACTERISTICS OF SURFACE-LAYER TURBULENCE | | |
| 4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Scientific. Interim. | | |
| 5. AUTHOR(S) <i>(First name, middle initial, last name)</i> J.C. Kaimal Y. Izumi J.C. Wyngaard O.R. Côté | | |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from the Quarterly Journal of the Royal Meteorological Society, Vol. 98, No. 417, July 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYB) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The behaviour of spectra and cospectra of turbulence in the surface layer is described within the framework of similarity theory using wind and temperature fluctuation data obtained in the 1968 AFCRL Kansas experiments. With appropriate normalization, the spectra and cospectra are each reduced to a family of curves which spread out according to z/L at low frequencies but converge to a single universal curve in the inertial subrange. The paper compares these results with data obtained by other investigators over both land and water. Spectral constants for velocity and temperature are determined and the variability in the recent estimates of the constants is discussed. The high-frequency behaviour is consistent with local isotropy. In the inertial subrange, where the spectra fall as $n^{-5/3}$, the cospectra fall faster; uw and $w\theta$ as $n^{-7/3}$, and $u\theta$, on the average, as $n^{-5/2}$. The 4/3 ratio between the transverse and longitudinal spectral levels is observed at wavelengths of the order of the height above ground under unstable conditions and at wavelengths of the order of $L/10$ under stable conditions. This lower isotropic limit is shown to be governed by the combined effects of shear and buoyancy on small-scale eddies. | | |
| KEYWORDS: Atmospheric turbulence, Surface layer, Spectra, Cospectra | | |

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| 3. REPORT TITLE A STATISTICAL APPROACH TO EVALUATING FOG DISPERSAL OPERATIONS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Bruce A. Kunkel | | |
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| 13. ABSTRACT <p>A statistical approach that can be used as an aid in evaluating the results and cost effectiveness of fog modification operations is presented. Ten years of visibility data from the WBAN records of those airfields that are prime candidates for fog modification experiments have been tabulated. From these data, climatic probabilities of visibility improvements to above minimum conditions for different times of the day have been obtained. Since the solar radiation is one of the prime factors in natural dispersal of fog, all times are normalized with respect to sunrise. As one would expect, the data show a marked increase in the probability of natural visibility improvement after sunrise. There is considerable variations in the climate probabilities of different stations reflecting the different types of fog regimes.</p> <p>Based on these conditional probabilities one can determine the number of tests required in order to have 95% confidence that the treatment is responsible for improving the visibility to above minimum conditions. This approach also provides a more suitable means of determining cost/benefit ratios. The claimed results of past seeding experiments are tested against this evaluation procedure.</p> | | |
| KEYWORDS: Warm fog dispersal, Weather modification, Conditional probabilities | | |

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THE DESIGN OF AN EFFICIENT THERMAL FOG DISPERSAL SYSTEM
FOR AIRPORTS4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific. Interim.5. AUTHOR(S) (First name, middle initial, last name)
Bruce A. Kunkel Charles Price
Bernard A. Silverman
Alan I. Weinstein

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13. ABSTRACT A ground based heating system for fog dispersal is being designed to efficiently distribute the heat over the target (runway) area. To aid in the design of such a system, a series of field experiments will be conducted at Vandenberg AFB in July 1972. An array of propane burners of varying intensities will be installed and the spatial distribution of the heat generated by the burners and its effect on the fog will be documented by an instrumented 200 ft tower, a lidar, a sonic radar and a .86 cm radar located downwind of the burners.

A numerical model has been developed which gives first order estimates on the optimum size and number of burners required to produce a operationally-useful clearing over the target area for various combinations of wind and stability conditions. The model predicts the bent-over trajectory of a continuous heat plume from either a single or line source of burners by considering the total buoyancy and momentum in a plume cross-section. An entrainment rate based on empirical data is assumed. The entrained fog water is assumed to evaporate instantly providing that plume is not saturated.

Results of some calculations with this model are presented to show the effects of burner intensity, burner spacing, wind, and stability conditions on the plume trajectories.

KEYWORDS: Warm fog dispersal, Weather modification, Heat plumes

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| 3. REPORT TITLE | | |
| A CIRCULATING PUMP FOR ULTRAPURE OR TOXIC GASES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) | | |
| C.C. Leiby, Jr. E.C. Dunton | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from The Review of Scientific Instruments, Vol. 43, No. 8, August 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PHF) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT | | |
| A small, stainless steel, Roots-type pump for gases is described. The pump employs helium leak tight rotary seals which render it suitable for use in ultrahigh vacuum gas handling systems. A throughput (at atmospheric pressure) of 100 liters/min has been measured at 1800 rpm. At higher rpm's, the throughput is correspondingly larger. | | |
| KEYWORDS: Ultrapure circulating pump, Roots pump | | |

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| | | 2b. GROUP |
| 3. REPORT TITLE PHOTOGRAMMETRICALLY DETERMINED CLOUD-FREE LINES-OF-SIGHT THROUGH THE ATMOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Iver A. Lund Milton D. Shanklin | | |
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| 13. ABSTRACT <p>Relative frequencies of cloud-free lines-of-sight were determined at specified elevation angles and directions by utilizing data from photographs taken with a camera with a 180° (fish-eye) lens and infrared film to produce high-quality photographs of the sky. Four summers of hourly daytime data were used to find relative frequencies as functions of viewing angle, sky cover, sunshine and cloud type. Persistence and recurrence relative frequencies, comparisions between "clear" and cloud-free lines-of-sight, and a general method for estimating probabilities of cloud-free lines-of-sight for any location are presented and discussed.</p> | | |
| KEYWORDS: Clouds, Seeing, Lines-of-sight, Optical seeing, Infrared seeing, Sky cover | | |

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| 3. REPORT TITLE CONTROLLED SECTIONING TECHNIQUE FOR SMALL GALLIUM ARSENIDE SAMPLES | | |
| 4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Scientific. Interim. | | |
| 5. AUTHOR(S) <i>(First name, middle initial, last name)</i> T.J. Magee J.J. Comer | | |
| 6. REPORT DATE 15 September 1972 | | 7a. TOTAL NO. OF PAGES 3 |
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| 11. SUPPLEMENTARY NOTES Reprinted from the Review of Scientific Instruments, Vol. 43, No. 8, August 1972. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LQO) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT A technique has been developed for sectioning small gallium arsenide samples utilizing anodic oxidation and subsequent removal of the oxide layers. It differs from those previously reported in that only one surface of the wafer is exposed during anodization and total immersion in the electrolyte is not required. The use of an ammonium pentaborate solution as the electrolyte and a relatively simple anodization apparatus has yielded oxide layers of uniform thickness on the surfaces of gallium arsenide wafers. After removing the oxide layers, the surfaces of the wafers were found to be relatively free of pitting and macroscopic defects. | | |
| KEY WORDS: Gallium arsenide, Oxidation, Sectioning, Specimen preparation, Surface layer | | |

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3. REPORT TITLE

CORRELATION OF SOLAR RADIO BURSTS AND SUDDEN INCREASES OF THE TOTAL ELECTRON CONTENT (SITEC) OF THE IONOSPHERE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

D.A. Matsoukas J.Aarons
M.D. Papagiannis J.A. Klobuchar

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L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Using as a guide AFCRL data of solar radio bursts with flux densities $S > 500$ flux units in the 245-35,000 MHz range, we have searched for sudden changes in total electron content (TEC) of the ionosphere. Both the radio burst and the TEC data used in this study were obtained at the AFCRL Radio Observatory at Sagamore Hill. From 2 yr of data we have found 19 cases showing clearly a sudden increase of the total electron content (SITEC) of the ionosphere. Radio bursts with peak flux density in the decimeter range (type G) showed no correlation with SITEC events. Approximately 50 percent of all the radio bursts which had a peak flux density $S > 500$ f.u. in the centimeter range showed SITEC's. The percentage increased with increasing peak flux density. The correlation was higher for flare events which occurred within 45° from the central meridian of the solar disc, but it was lower for events that occurred in the early morning hours. The probability reaches nearly 100 percent when the flare event appears within 45° of the central meridian of the Sun, occurs at local noon or in the early afternoon, and has a peak flux density $S > 1000$ f.u. in the centimeter range.

KEYWORDS: Total electron content, Solar radio bursts, SITEC

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| 5. AUTHOR(S) (First name, middle initial, last name) Robert A. McClatchey | | |
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| 13. ABSTRACT Accurate transmittance functions appropriate for use in remote temperature sensing of the atmosphere have been computed based on degraded, monochromatic calculations. These calculations have been done both in the 4.3μm and in the 15μm regions and include the effects of water vapor, ozone, and nitrous oxide as well as carbon dioxide. Calculations have been made for three atmospheric models (tropical, standard, and arctic) in which the temperature, ozone and water vapor distributions differ. Separate calculations are also provided for water vapor and ozone absorption independently in the same spectral regions. The effect of transmittance variations in these two spectral regions and the impact on remote temperature probing are discussed. | | |
| KEY WORDS: Remote temperature probing, Atmospheric transmittance | | |

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DIRECT MEASUREMENT OF THE SEMI-ANNUAL VARIATION DURING 1968

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5. AUTHOR(S) (First name, middle initial, last name)

J. P. McIsaac
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12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research
Laboratories (LKB)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

The Air Force Satellite OV3-6 (1967-120A) placed into orbit on 4 December 1967 carried onboard a cold-cathode ionization gauge for direct measurement of atmospheric density. Measurements were made during the semi-annual minimum period (January/February) and maximum period (March/April). Results from these measurements are presented as ratios of maximum to minimum density. Values are adjusted to a fixed solar flux ($10^{22} F_{10,7}=150$). Magnitudes of the April/January ratios are shown as functions of date. The gauge ratios are in agreement with Cook's density ratios from the orbital drag on the same satellite. Comparisons are made with the Jacchia 71 model predictions and the gauge measured semi-annual variation is found to be significantly larger.

KEYWORDS: Neutral atmosphere, Semi-annual variation, Satellite measurements
Daytime densities

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| 3. REPORT TITLE OBSERVATIONS AND INTERPRETATION OF SUPERGRANULE VELOCITY AND MAGNETIC FIELDS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Steven Musman | | |
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| 13. ABSTRACT I have studied the observed concentrations of vertical velocity and vertical magnetic field in the corners of the coarse network. Using a horizontal velocity inferred from the vertical velocity, I have computed the possible rate of concentration of the field. The rate turns out to be much higher than observed. I conclude that the observed motions in supergranules are not concentrating the observed field at the corners of the network. I have suggested four possible alternate situations consistent with the observations. | | |
| KEYWORDS: Solar magnetic fields, Solar velocity fields, Solar supergranules | | |

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| 3. REPORT TITLE THE EFFECT OF FINITE RESOLUTION ON SOLAR GRANULATION | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) Steven Musman | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Solar Physics 7 (1969) 178-186. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT Some numerical experiments were performed in order to simulate the effect of finite resolution on solar granulation. When a two-dimensional pattern is smeared, another pattern emerges whose nature depends on the width of the smearing function rather than the original pattern. The size of the structures present in a typical granulation photograph is about that which would be expected from the smearing of smaller structures by the effect of atmospheric 'seeing'. Only Stratoscope photographs appear to have unambiguously determined the nature of solar granulation. | | |
| KEYWORDS: Solar photosphere, Solar granulation | | |

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| 3. REPORT TITLE VERTICAL VELOCITIES AND HORIZONTAL WAVE PROPAGATION IN THE SOLAR PHOTOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Steven Musman David M. Rust | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Solar Physics 13 (1970) 261-286. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LM) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT We used the Sacramento Peak Doppler-Zeeman Analyzer to study the velocity and magnetic fields in 60"×300" areas on the solar disk. We map the steady component of the line-of-sight velocity and longitudinal magnetic fields and compare them with the coarse Ca ⁺ network. The collective phase behavior of the 5-min oscillations is studied in detail. We find large scale phase coherence, including waves with typical horizontal phase velocities of 100 km/sec which can be followed up to 50 000 km. The important oscillatory features are interpreted in terms of the properties of modified sound waves. We find no apparent relationship between the steady and oscillatory fields. | | |
| KEYWORDS: Solar photosphere, Solar velocity fields, Magnetic fields | | |

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| 3. REPORT TITLE COMPOSITION STUDIES OF THE LOWER IONOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Rocco S. Narcisi | | |
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| 13. ABSTRACT This paper is limited to positive ion studies only. A fairly detailed description of the instrumentation and techniques for D and E region measurements is first presented. The aerodynamics and plasmadynamics associated with lower ionospheric measurements is then described, followed by a discussion of the methods, limitations and uncertainties in the interpretation of the measured ion currents into ambient ionosphere parameters. The D region measurements and the present state of D region theory, including the suggested ion chemical origin of water cluster ions are summarized in succeeding sections. Finally, some E region results are presented and these are compared with the predictions of a new diurnal model of the E region which includes both ion chemistry and ion transport. | | |
| KEYWORDS: Rocket mass spectrometers, Plasmadynamics, Positive ions, Ionosphere, D region, E region, Composition measurements, Ionospheric theories | | |

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| 3. REPORT TITLE THE INTERPRETATION OF VELOCITY FILTERGRAMS I: The Effective Depth of Line Formation | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) R.L. Parnell J.M. Beckers | | |
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| 13. ABSTRACT The paper describes a numerical experiment in which the effect of an assumed velocity distribution in the solar atmosphere on the intensity difference between a blue- and a red-wing filtergram is derived. This results in the effective optical depth at which the velocity is measured. It is shown that this τ_{eff} strongly depends on the assumed velocity distribution. | | |
| KEY WORDS: Solar velocity fields, Solar atmosphere | | |

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3. REPORT TITLE
DEPARTURE OF N_2^+ ($B^2\Sigma_u^+$, $v' = 2$ and 3) VIBRATIONAL POPULATIONS FROM FRANCK-CONDON PREDICTIONS IN THE CASE OF ENERGETIC $e^-N_2(X^1\Sigma_g^+, v=0)$ COLLISIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)

W.R. Pendleton, Jr.
Robert R. O'Neil

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13. ABSTRACT Evidence is presented for a departure of the vibrational distributions of $N_2^+(B^2\Sigma_u^+, v'=2, 3)$ ions formed in single collision of energetic electrons and $N_2(X^1\Sigma_g^+, v=0)$ molecules from that based on a simple Frank-Condon model involving simultaneous ionization and excitation of the neutral molecule. In this study relative band intensities of the N_2^+ first negative ($B^2\Sigma_u^+ - X^2\Sigma_g^+$) $\Delta v=-2, -1$ and +1 sequences were examined for 1.5 keV electron impact on a 300°K $N_2(X^1\Sigma_g^+)$ target at a pressure of $\approx 10^{-4}$ Torr. The measurements verify and extend previous results reported by other workers. Theoretical N_2^+ first negative relative photon emission rates calculated assuming excitation and emission probabilities proportioned to Frank-Condon factors are compared with measured relative band intensities. Within each v'' progression ($v' < \text{constant}$) a constant ratio of experimental to theoretical band intensities was observed. Normalizing the experimental to theoretical ratio to unity for the $v'=0$ progression, the ratios for the $v'=1, 2$ and 3 progressions are 1, 5 and 170 respectively. Implication of the apparent departure of the N_2^+ B-state $v'=2$ and 3 populations from Frank-Condon values are discussed.

KEYWORDS: Electron nitrogen collision, N_2^+ first negative vibrational populations

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| 3. REPORT TITLE BEAM SPREADING IN A TURBULENT MEDIUM | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) J.L. Poirier D. Korff | | |
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| 13. ABSTRACT <p>The Kolmogorov spectrum with its associated structure functions is generally used to study wave propagation in turbulent media. It is known, however, that this spectrum does not accurately represent the real atmosphere outside the inertial range. In this paper, the broadening of a focused gaussian beam is calculated, using instead a modified von Karman spectrum better to describe the medium. The Born approximation is also used, because it follows naturally from the use of this spectrum. The dependence of beam spreading on the outer scale of turbulence is obtained and the results generally reduce to those corresponding to the Kolmogorov spectrum and the Rytov approximation, which in fact do not depend on the outer scale of turbulence. The results can be applied to arbitrary source configurations or extended to include the calculation of other field quantities of interest.</p> | | |
| KEYWORDS: Laser, Coherence, Turbulence, Beam spreading, Atmospheric optics | | |

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| 3. REPORT TITLE | | |
| THE EFFECT OF OXYGEN AND BENZOQUINONE CONCENTRATION ON THE REVERSIBLE SPECTROPHOTOMETRIC CHANGES ACCOMPANYING THE PHOTOOXIDATION OF PORPHYRINS AT LOW pH VALUES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) | | |
| Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) | | |
| Kenneth P. Quinlan | | |
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| 13. ABSTRACT Oxygen has little or no effect on the spectrophotometric changes accompanying the reversible photooxidation of porphyrins by benzoquinone at low pH values. High concentrations of benzoquinone inhibit these reversible changes. Spectral evidence is presented to indicate that the porphyrin may be undergoing different photooxidative process at different pH values. | | |
| KEY WORDS: Oxygen, Benzoquinone, Photooxidation, Porphyrins | | |

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3. REPORT TITLE

THE EFFECT OF ASYMMETRY ON TOROIDAL HYDROMAGNETIC WAVES
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5. AUTHOR(S) (First name, middle initial, last name)

Henry R. Radoski

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13. ABSTRACT

The meridional and azimuthal electric wave fields are considered as the characteristic toroidal and poloidal components. Neglecting the exchange of energy between these fields leads to a toroidal mode wave equation which retains the principal longitudinal or asymmetric contribution. The asymmetric spectrum appears as a logical extension of the results for the symmetric field line oscillations. The model for this study consists of a dipole field magnetized plasma, whose density is commensurate with conditions in the plasmapause. Eigenperiods are calculated for a broad range of asymmetric modes. Because of the similarity in the latitudinal variation between the symmetric and asymmetric periods, it is imperative to revise current idealized magnetospheric models and incorporate such similarity in future models.

KEYWORDS: Hydromagnetic wave, Micropulsations, Resonances

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| 3. REPORT TITLE A CASE STUDY OF PERSISTENT, INTENSE, CLEAR AIR TURBULENCE IN AN UPPER LEVEL FRONTAL ZONE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Richard J. Reed Kenneth R. Hardy | | |
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| 13. ABSTRACT Widespread and persistent clear air turbulence (CAT) occurred over the Eastern Seaboard of the United States between New York and South Carolina on 18 March 1969. The major synoptic features and a qualitative discussion of the factors contributing to the development of the large vertical wind shears associated with the turbulence are presented. The turbulent region in the vicinity of Wallops Island, Va., was probed with a NASA T-33 research aircraft and with sensitive radars. The clear air radar echoes and the most intense turbulence occurred principally within an upper level frontal zone of about 2 km depth which was produced by the confluence of two currents of widely different origin. The smoothed Richardson number was less than 1.0 throughout the zone and reached its lowest value of ~0.25 in the region of strongest turbulence. Three distinct types of wave structures were evident in the clear air radar echoes. These were: 1) long sinusoidal arches moving at approximately the wind speed which were oriented in the direction of the wind and wind shear and which had wavelengths of 15-30 km and crest-to-trough amplitudes of nearly 2 km; 2) unstable waves or billows of about 1.6 km wavelength which were superposed on a portion of the long arches and were also oriented in the shear direction; and 3) braided wave-like patterns having a wavelength of ~5 km and a crest-to-trough amplitude of more than 1 km which were oriented in the cross-wind (and cross-shear) direction. KEYWORDS: Clear air turbulence, Radar echo, Wind shear, Radar scattering | | |

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Air Force Cambridge Research
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L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

Analysis of frequency distribution of vertical shear of horizontal winds is reported for 2000 samples obtained between 90 and 136 km. The distribution is independent of altitude when shears are normalized by dividing by limiting shears of $.075 \text{ sec}^{-1}$ below 110 km, decreasing to $.035 \text{ sec}^{-1}$ at 128 km. Associated vertical wavelengths are also altitude independent when normalized, with shortest wavelengths increasing from 3 km at 90 km to 10 km at 136 km. The Richardson number, as a criterion of turbulence, shows that 7% of space/time samples below 110 km will permit turbulence to initiate, while no samples above 115 km will permit onset of turbulence. Viscosities (computed by Hines equation relating viscosity and limiting wavelength) are 30-fold greater than molecular at 90 km, approaching molecular above 115 km. The rate of deposition through viscous shear is $2000\text{-}4000 \text{ erg g}^{-1} \text{ sec}^{-1}$, but 10% of the samples have a five-fold higher rate, which will significantly affect temperature profiles. The shears found are capable of increasing molecular ion and electron density to about $4 \times 10^3 \text{ cm}^{-3}$ from background ionization levels below 10^3 cm^{-3} , and to $2 \times 10^4 \text{ cm}^{-3}$ from backgrounds of 10^4 cm^{-3} . They cannot significantly enhance 10^5 cm^{-3} backgrounds.

KEYWORDS: Shear turbulence viscosities, Winds

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| 3. REPORT TITLE MICROWAVE MEASUREMENTS OF FLOW FIELD CHARACTERISTICS AT THE STAGNATION POINT OF A BLUNT REENTRY BODY | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Walter Rotman | | |
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| 13. ABSTRACT Plasma diagnostic sensors, including microwave antennas and electrostatic probes, are used to measure the flow fields at the stagnation point of a blunt nose cone during atmospheric reentry. The microwave measurements determine signal attenuation, reflection coefficient, and mutual antenna coupling as a function of altitude. The flight data are compared with calculations of flow field ionization and antenna performance, based upon three competitive flow field models. Excellent agreement is obtained at high altitudes only for that flow field model which includes both viscous interaction across the entire shock layer and vibrational nonequilibrium effects. These results are further confirmed by comparison with probe data and observations from another flight program. | | |
| KEYWORDS: Reentry vehicles, Aerodynamic flow fields, Atmospheric reentry, Plasma sheath, Microwave antennas | | |

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3. REPORT TITLE

SOME EFFECTS OF NEUTRAL WIND CHANGES ON THE
LOW-LATITUDE F-REGION

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific. Interim.

5. AUTHOR(S) (First name, middle initial, last name)

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13. ABSTRACT

Using the time-dependent continuity equation, the effects of changes in the phase of a diurnally varying neutral air wind on the ionization distribution in the low-latitude F-region is assessed. It is seen that the time at which the Appleton anomaly disappears varies when the phase of the meridional neutral wind changes, with the anomaly persisting longer when the wind has its maximum poleward speed earlier in the day. At times when the anomaly is well developed (1200-2000 hr), the wind exerts little influence on its structure. Poleward of the anomaly, however, the dependence of the ionization distribution on the phase of the neutral wind is similar to that seen for the mid-latitude F-region.

KEYWORDS: Neutral air winds, Equatorial F region, Appleton anomaly

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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Hari K. Sen Marvin L. White | | |
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| 13. ABSTRACT The weakly ionized photospheric layer in the sunspot environment satisfies certain dynamo inequalities (Equations (11) and (13)) resulting in photospheric Hall current systems. The corresponding Joule dissipation is associated with the surrounding plage area. For critical values of the 'driving' or convective winds (speeds > 1km/s), two stream instability results. The computed energy is of the order of that found in solar flares. | | |
| KEYWORDS: Jet streams, Solar system | | |

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| 3. REPORT TITLE A COMPARISON BETWEEN THE EFFECTS OF FOURIER TRUNCATION AND A CLASS OF LINEAR DIGITAL FILTERS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Ralph Shapiro | | |
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| 13. ABSTRACT <p>The desirable properties of a certain class of linear digital filters are discussed and compared with the use of both linear and nonlinear diffusion operators as parameterizations of sub-grid-scale atmospheric diffusion. These filters are characterized as "ideal" in the sense that for any order n, the filter removes the smallest resolvable wave component (the two grid-interval wave) but produces a minimum of damping of all longer waves without introducing any phase shifts or extraneous wave components. Such filters are simple to use and can easily be designed to suit a variety of purposes. The filter is compared with the Fast Fourier Transform for speed and efficiency with specific application to sub-grid-scale parameterization in mathematical models of the large-scale atmospheric circulation.</p> | | |
| KEYWORDS: Digital filter, Gast Fourier transform, Sub-grid-scale diffusion | | |

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| <table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="3" style="text-align: center;">13. ABSTRACT</td> </tr> <tr> <td colspan="3">A general operator of arbitrary order is developed for the purpose of minimizing the deleterious truncation and aliasing effects introduced by interpolation. The effects of interpolation are discussed for both uniform and mixed grid systems and the properties of the restoration operator are demonstrated by means of a series of computations on the sea-level pressure distribution around latitude circles. For geophysical applications, a low ordered operator is shown to be effective in restoring physically significant information which is lost during interpolation. It is inferred from the properties of the restoration operator that it may find useful application in avoiding computational instability in cases where interpolation is involved.</td> </tr> </table> | | 13. ABSTRACT | | | A general operator of arbitrary order is developed for the purpose of minimizing the deleterious truncation and aliasing effects introduced by interpolation. The effects of interpolation are discussed for both uniform and mixed grid systems and the properties of the restoration operator are demonstrated by means of a series of computations on the sea-level pressure distribution around latitude circles. For geophysical applications, a low ordered operator is shown to be effective in restoring physically significant information which is lost during interpolation. It is inferred from the properties of the restoration operator that it may find useful application in avoiding computational instability in cases where interpolation is involved. | | |
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| KEYWORDS: Interpolation, Transfer function, Mixed grid systems, Information loss | | | | | | | |

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Bedford, Massachusetts 01730

13. ABSTRACT Previous model studies and field experiments have demonstrated the technical feasibility of improving the visibility of warm fog to operationally-useful levels by single and multiple line aircraft seeding with sized sodium chloride particles. This paper describes the results of a test program conducted at McClellan AFB, California to determine the practicability of implementing this technique at an airport on an operational basis. Model calculations were used to design the seeding tests for the climatologically-expected wind and fog conditions. Urea was chosen as the most practical seeding agent for these tests since it is non-corrosive to metals, non-toxic, and it is beneficial to plant life. The urea particles were microencapsulated in a thin ethylcellulose shell to provide for a well-sized spectrum of seeding particles that does not degenerate during storage, handling, or dissemination.

It was found that the seeding aircraft could be accurately positioned at offset distances up to 1000 feet from the centerline of the runway using standard precision approach radar (PAR) that is available at most airports. The single line seeding technique is, however, not a practical technique for warm fog dissipation due to the extreme difficulty in targeting the cleared zone. Many fogs in which winds were measured as calm by standard airport instrumentation actually had surface winds as high as 2 knots and stronger winds aloft. Because of the practical limitations on maximum allowable offset, seedable fog occurrences are fewer than might be expected from climatological records. Under light wind conditions, when offset distances are within specified limits, the wind direction is highly variable making it difficult to forecast the trajectory of the cleared zone.

DD FORM 1 NOV 65 1473 Wide area seeding techniques offer the best hope for oversoming the targeting problem. KEYWORDS: Warm fog dispersal, Weather modification, Unclassified, Hygroscopic particle seeding

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| 3. REPORT TITLE SUPERGRANULES AND THE HYDROGEN CONVECTION ZONE | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) G. W. Simon N. W. Weiss | | |
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| 13. ABSTRACT Solar granules and supergranules are characterized by two different length scales. Orthodox mixing length theory cannot account for the preferred diameter of 30 000 km observed in supergranules. However, convective heat transport can be more efficient if the motion extends over several scale heights. The physics of convection in a polytropic atmosphere is discussed and the results are used to construct a model of convection in the sun. This model explains the generation of both photospheric granules and supergranules and also suggests the existence of giant cells formed near the base of the convection zone. | | |
| KEYWORDS: Solar photospheres, Solar convection zone, Solar granulation | | |

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| 5. AUTHOR(S) (First name, middle initial, last name) A. J. Slobodnik, Jr. | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Journal Applied Physics, Vol. 43, No. 6, June 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZM) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Experimental measurements of microwave acoustic surface-wave attenuation due to propagation at the boundary of a solid and a monatomic gas are presented. Data illustrate attenuation as a function of frequency, molecular weight, pressure, and temperature. Experimental results are compared to both an approximate and a continuum mechanical theory. For the frequencies of interest (500-2500 MHz) the approximate theory gives better agreement with experiment. A summary of data of attenuation due to air loading at 1 GHz is presented for a number of low-loss acoustic surface-wave substrates. Of practical interest is the fact that microwave acoustic surface-wave delay lines and other signal-processing devices must be encapsulated in either helium or vacuum if minimum insertion loss is desired. | | |
| KEYWORDS: Acoustic delay lines, Acoustic surface waves, Acoustic leaky waves, Monatomic gases, Gas loading | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LZN) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE GaAs ACOUSTIC-SURFACE-WAVE PROPAGATION LOSSES AT 1 GHz | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) A.J. Slobodnik, Jr. | | |
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| 13. ABSTRACT Measurements of acoustic-surface wave propagation losses in air have yielded the following for GaAs 1 GHz: 3.62 dB/ μ s for the [211] cut, [111] propagating orientation, and 4.22 dB/ μ s for the [110] cut, [100] propagating orientation. Air loading for these two cuts is 0.27 and 0.40 dB/ μ s, respectively. These results are independent of surface quality for defects up to 0.04 wavelengths in size. | | |
| KEYWORDS: Microwave acoustics, Acoustic surface waves, Surface wave propagation loss, Gallium arsenide | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LZM) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| 3. REPORT TITLE ACOUSTIC SURFACE WAVE LOSS MECHANISMS ON Bi ₁₂ GeO ₂₀ AT MICROWAVE FREQUENCIES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) A.J. Slobodnik, Jr. A.J. Budreau | | |
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| 13. ABSTRACT <p>Measurements of the acoustic surface wave propagation loss in vacuum on both 001-cut and 111-cut 110-propagating Bi₁₂GeO₂₀ have been made between 200 and 2000 MHz. Approximate f-squared frequency dependence was obtained with a value at 1 GHz of 1.45 dB/μsec. Temperature-dependence measurements illustrate the loss peaks in the vicinity of 50-100 K which are characteristic of Bi₁₂GeO₂₀. The difference in loss between 298 and 4.2 K agrees with over-all room-temperature data indicating attenuation is inherent to the crystal itself and not due to imperfections. Air loading contributes an additional loss of 0.19 dB/μsec at 1 GHz. Beam steering and diffraction considerations illustrate the superiority of the 001 cut over the 111 cut. For linear operation at 320 MHz, surface wave devices on 001-cut 110-propagating Bi₁₂GeO₂₀ should be limited to power densities of 9 mW/mm.</p> | | |
| KEYWORDS: Acoustic surface wave attenuation, Bismuth germanium oxide, Beam steering, Diffraction, Frequency dependence of loss | | |

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| 3. REPORT TITLE REPLY | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from the Journal of Geophysical Research, Vol. 77, No. 10, April 1, 1972. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT There appears to be too much NO in the D region, a fact recognized by many, and a suitable $\text{NO}^+ \rightarrow \text{N}_3\text{O}^+ \cdot (\text{H}_2\text{O})_n$ reaction sequence is unknown. The ability of atomic oxygen to react exothermically with every known $\text{NO}^+ \cdot \text{X}$ ion, yielding $\text{NO}_2^+ + \text{X}$, apparently contributes to the difficulty of $\text{NO}^+ \rightarrow \text{H}_3\text{O}^+ \cdot (\text{H}_2\text{O})$ conversions. If NO is much less than the measurements indicate below 85 km, perhaps ionization of some other constituent is responsible for the D region. | | |
| KEYWORDS: Ionosphere, D-region, Mesosphere, Atmospheric ion chemistry, Electron concentrations | | |

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3. REPORT TITLE

ABSORPTION SPECTRUM OF HD IN THE VACUUM-UV REGION.
RYDBERG STATES AND IONIZATION ENERGY

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5. AUTHOR(S) (First name, middle initial, last name)

S. Takezawa
Y. Tanaka

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Air Force Cambridge Research
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L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

The absorption spectrum of the HD molecule has been investigated in the 950-600 Å region with a 6.65-m normal-incidence vacuum spectrograph in the second order using the helium continuum as a light source. In the spectrum of cooled HD, seven Rydberg series are identified. Four consist of the Q(1) lines in the np $\pi \leftarrow X$ transitions and convergion to the $v=0, 1, 2$, and 3 levels of the HD⁺ ground state. The other three are identified as the R(0) series of the np $\sigma \leftarrow X$ transitions, converging to the $v=0$ and 1 levels, and the R(0) series of the np $\pi \leftarrow X$ transitions converging to the $v=1$ level of the HD⁺ ground state. The lowest ionization energy ($v=0, N=0$) of this molecule, obtained from the Q(1) series, is $124\,569.5 \pm 0.6$ cm⁻¹. Eight additional Rydberg series, observed near their series limits and identified as either R(0) or R(1) series, are also reported.

KEYWORDS: Absorption, Spectrum, HD-molecule, Ionization energy

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| 3. REPORT TITLE ELASTODYNAMIC NEAR FIELD OF A FINITE PROPAGATING TRANSVERSE SHEAR FAULT | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Ker C. Thomson N.A. Haskell | | |
| 6. REPORT DATE 20 July 1972 | | 7a. TOTAL NO. OF PAGES 9 |
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| 13. ABSTRACT A quantitative model of the earthquake focal mechanism incorporating finite source dimensions and finite nonzero rupture velocity has been developed. There are three linearly independent cases: longitudinal shear fault, tensile fault, and transverse shear fault. This paper completes the theory by developing the case of transverse shear faulting, which was not considered earlier. Near-field displacement, particle velocity, and acceleration wave forms were computed by numerically integrating the Green function integrals for an infinite medium. The results are displayed as graphical wave forms at an extensive selection of close-in field positions and as contour plots of amplitude on particular planes. | | |
| KEYWORDS: Shear faults, Elastodynamics, Propagating transverse faults | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LYP) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE WARM FOG DISPERSAL BY AIRBORNE WIDE AREA HYGROSCOPIC PARTICLE SEEDING | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Alan I. Weinstein Bernard A. Silverman | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Preprint Volume of the Third Conference on Weather Modification, June 26-29, 1972, Rapid City, South Dakota | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYP) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Previous numerical calculations and field experiments showed that single- or multiple-line airborne hygroscopic particle seeding produces only limited visibility improvement in warm fog under realistic wind and turbulence conditions. The effectiveness of this technique is limited due to 1) the action of turbulent diffusion and wind shear which reduce the number concentration of seeding material to a level too low to sustain clearing as unmodified fog refills the opening, and 2) the practical difficulty, in the presence of the rapidly varying wind normally encountered in warm fog, of targeting any clearing that does develop. Wide area/low concentration airborne particle seeding holds potential for overcoming the diffusion, wind shear, and targeting problems of line seeding. The areas are larger and the concentrations smaller by an order of magnitude than those involved in line seeding. | | |
| The two dimensional, time dependent, Eulerian model of warm fog dispersal used in the earlier numerical studies, is used here to calculate different combinations of 1) seeded area dimensions, 2) concentration and size distribution of the seeding material, and 3) upwind distance to the target required to produce significant visibility improvements in fog under realistic wind and turbulence conditions. | | |
| KEYWORDS: Warm fog dispersal, Weather modification, Hygroscopic particle, Seeding | | |

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| (Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) | | |
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| 3. REPORT TITLE COSPECTRAL SIMILARITY IN THE ATMOSPHERIC SURFACE LAYER | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) J. C. Wyngaard O. R. Cote | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from the Quarterly Journal of the Royal Meteorological Society, Vol. 98, No. 417, July 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYB) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT There are two asymptotic cases where the four parameters which determine surface layer turbulence structure reduce to three. In the unstable limit, which we call local free convection, the surface stress is no longer important. In the stable limit z no longer enters; we propose the name 'local z -less stratification' for this state. In both cases explicit predictions result for various properties of the cospectra of stress and heat flux. Although the predictions are based on asymptotic arguments and therefore might be expected to hold only at large $ z/L $ values, data from the 1968 Kansas experiments show that most predictions are valid fairly close to neutral. | | |
| KEY WORDS: Atm. turbulence, Surface layer, Similarity, Cospectra | | |

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3. REPORT TITLE

AN EFFICIENT NUMERICAL SCHEME FOR A BAROCLINIC
QUASI-GEOSTROPHIC MODEL

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Samuel Y. K. Yee

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| 11. SUPPLEMENTARY NOTES Reprinted from Journal of Computational Physics, Vol. 9, No. 3, June 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LYD) L.G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT

An efficient numerical scheme for solving a multilevel geostrophic forecast model having consistent first-order approximations is presented. The approach involves eliminating the vertical velocity between the vorticity and thermodynamic equations to yield a three-dimensional prognostic equation, reducing this three-dimensional equation to two-dimensional by an orthogonal transformation, and solving the transformed system by an iterative method. The scheme is shown to be at least four times as efficient as another popular scheme. Time integrations using NMC-analysed grid-point geopotential as initial data are carried out for calibration purposes. Finally, advantages and implications of such a scheme are discussed.

KEY WORDS: Quasi-geostrophic model, Numerical weather prediction, Initial-boundary value problem, Orthogonal transformation

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE THE MEASUREMENT OF ATMOSPHERIC STABILITY FROM 30 TO ~90 KM | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) S. P. Zimmerman A.C. Faire E.A. Murphy | | |
| 6. REPORT DATE 28 August 1972 | 7a. TOTAL NO. OF PAGES 8 | 7b. NO. OF REFS 8 |
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| 10. DISTRIBUTION STATEMENT Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from Space Research XII, Akademie-Verlag, Berlin 1972. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Three years of wind and temperature data determined from grenade experiments at six sites are utilized in the calculation of the Richardson number R_i . The results show that, for a critical Richardson number of 1, there is quite often a turbulent region around 85 km at all latitudes. Furthermore, the winter polar mesospheric data indicate a more intense turbulence than do the summer data. There also appears a region of marginal stability ($R_i \sim 1$) at or slightly above the stratopause which is more often present during the winter season than in the summer. Latitudinal and seasonal distributions of Richardson number, wind shears and estimates of heating rates due to viscous dissipation of turbulent kinetic energy are given. | | |
| Richardson number, Atmospheric stability, KEY WORDS: Turbulence, Internal gravity waves, Viscous deposition | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Air Force Cambridge Research Laboratories (LKB) L.G. Hanscom Field Bedford, Massachusetts 01730 | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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3. REPORT TITLE

WIND ENERGY DEPOSITION IN THE UPPER ATMOSPHERE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
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5. AUTHOR(S) (First name, middle initial, last name)

S. P. Zimmerman
N. W. Rosenberg6. REPORT DATE
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Laboratories (LKB)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT

The rate of viscous damping of upper atmospheric winds (between 90 and 150 km) has been computed for 70 mid-latitude wind profiles. The contribution of high spatial frequency vertical shears to the energy deposition in this altitude region has been calculated for each profile by filtering out the low spatial frequencies. Viscous energy deposition per unit volume is highest between 90 and 95 km, and decreases with increasing altitude. At 95 km, the winter deposition rate is $\sim 1.0 \times 10^{-5}$ ergs $\text{cm}^{-3} \text{ s}^{-1}$ for a quarter of the time, representing an instantaneous source of local heating ten times that due to Schumann-Runge continuum absorption in the same altitude region.

KEYWORDS: Wind energy, Turbulence, Internal gravity waves, Viscous deposition, Richardson number

Part III
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| 1. ORIGINATING ACTIVITY (Corporate author) Adcole Corporation 330 Bear Hill Rd. Waltham, Mass. 02154 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE ELECTRONIC INSTRUMENTATION FOR SOLAR RADIATION MEASUREMENTS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final. 1 Feb. '68 - 31 Dec. '71 Approved 28 Feb. '72 | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Emilio A. Zeuli | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY A.F.C.R.L. (LK) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT This report describes the design, construction, test and flight of the electronic portions of research instruments used on rockets and satellites for the investigation of extreme solar ultraviolet radiation. These instruments are grazing incidence grating monochromators for measurements in the 30-1300 Angstrom range, and retarding potential analyzers used for analysis of environmental charged particles. All the instruments are of a telemetering type. Associated equipment used for calibration and testing of the instruments in both the laboratory and the pre-launch phases is described. Automatic data reduction equipment was developed and used successfully. Experiments were flown on Aerobee 150, Aerobee 170, and Black Brant rockets, and the OV5-6 satellite. | | |
| KEYWORDS: Electronics, Solar radiation, Extreme ultraviolet | | |

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KEYWORDS: Ionospheric data processing, Ionogram reduction

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| 1. ORIGINATING ACTIVITY (Corporate author) Banaras Hindu University Varanasi 5, India | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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3. REPORT TITLE

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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)

P. K. Shukla
R. N. Singh6. REPORT DATE
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Laboratories (LI)
L. G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT A general theory of energy attenuation of a charged test particle in a cold, collisional plasma has been developed. The effect of collisions on the plasma properties have been investigated. The radiation characteristics of a spiralling test particle are discussed. In the presence of collisions it is found that absorption is important when the collision frequency is comparable to the wave frequency. Estimates of radiated and absorbed power by test charges of different energies have been made, and the role of collisions on the power spectrum has been studied in detail.

KEYWORDS: Theory, Energy attenuation, Charged test particle

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| 1. ORIGINATING ACTIVITY (Corporate author) Banaras Hindu University Varanasi 5, India | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE EFFECTIVE COLLISION FREQUENCY AND RADIO FREQUENCY CONDUCTIVITY IN THE MAGNETOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) P. K. Shukla K. D. Misra R. N. Singh | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from J. of the Institution of Telecom. Engrs, Vol. 16, No. 8, pp 616-621, 1970 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The electron density and electron temperature profiles have been chosen, and with help of these data the effective electron collision frequency along various geomagnetic lines of force have been calculated. The effective electron collision frequency in the entire magnetosphere is very low ($v = 1 - 10^{-4}$ sec ⁻¹). The effective collision frequency profile in the upper ionosphere has been calculated which agrees well the measured values. Using effective electron collision frequency we have calculated the radio frequency conductivity of magnetospheric plasma from two considerations, namely the kinetic theory considerations and with the help of Boltzmann transport equation. The results obtained from both the methods are compared and applicability of both the methods are discussed. The role of radio frequency conductivity in electromagnetic wave propagation has been discussed. It is argued that the electron density inhomogeneity or plasma turbulence may decrease the conductivity considerably giving rise to large electric field which energizes the charged particles moving along the geomagnetic lines of force. | | |

KEYWORDS: Calculation, Electron collision frequency, Magnetosphere

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KEYWORDS: VLF, Propagation, Refractive index, Group velocity

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| 1. ORIGINATING ACTIVITY (Corporate author) Banaras Hindu University Varanasi 5, India | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE PERIODIC ENERGIZATION OF ELECTRONS DUE TO ELECTROMAGNETIC WAVES PROPAGATING THROUGH MAGNETOPLASMA-I | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Omkar Nath R. N. Singh | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Int. J. Electronics, Vol. 30, No. 2, pp 149-160, 1971 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Interaction of streaming electrons and low frequency electromagnetic waves, both confined to a geomagnetic tube of force, has been studied. Following Roberts and Buchsbaum's theory it is shown that electron energy gain is oscillatory. Considering low energy (<10ev) electrons the time period of energy oscillation is found to be maximum at the equator for $\omega \leq 15\text{kHz}$ and increases with increasing frequency. For $15 \leq \omega \leq 100\text{kHz}$ the maximum time period of energy oscillation is found to be almost constant ($5 \cdot 3 \times 10^{-2}\text{ sec}$) in the entire band of frequencies. The maximum time period shifts towards high latitude with increasing frequencies, whereas, for high energy (100 keV) electrons the time period of energy oscillation increases with the increasing latitude and at high latitude (65°) the time period is almost constant ($0 \cdot 98 \times 10^{-2}\text{ sec}$) for waves of different frequencies. The energy gain is found to increase steadily with increasing latitude. Observed periodic geophysical phenomena have been interpreted in terms of calculated results and their significance has been discussed. | | |

KEYWORDS: Wave particle interaction, Low energy electrons

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| 1. ORIGINATING ACTIVITY (Corporate author) Banares Hindu University Varanasi 5, India | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE EFFECT OF PLASMA INHOMOGENEITY AND DRIFTING PLASMA ON SYNCHROTRON RADIATION FROM MAGNETOPLASMA | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) P. K. Shukla R. N. Singh | | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from Int. J. Electronics, Vol. 29, No. 4, pp 369-375, 1970 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The synchrotron radiation from relativistic charged particles gyrating along a static magnetic field is affected by the background medium. We have shown the effect of uniform magnetoplasma, the plasma inhomogeneity and the drifting plasma on the synchrotron radiation. The radiated synchrotron power for frequencies $f/f_c \leq 1$ is found to decrease due to the presence of drifting plasma and the synchrotron power in the same frequency range is found to increase due to the presence of plasma inhomogeneity. For frequencies $f/f_c \geq 1$ the plasma inhomogeneity and drifting plasma show negligible effect. | | |

KEYWORDS: Synchrotron radiation, Relativistic particles, Magnetoplasma

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| 3. REPORT TITLE PROPAGATION OF AN ELECTROMAGNETIC PULSE THROUGH INHOMOGENEOUS PLASMA | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) K. P. Singh P. K. Shukla R. N. Singh | | |
| 6. REPORT DATE 1971 | 7a. TOTAL NO. OF PAGES 6 | 7b. NO. OF REFS 3 |
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| 11. SUPPLEMENTARY NOTES Reprinted from Int. J. Electronics, Vol. 30, No. 3, pp 249-254, 1971 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The propagation of electromagnetic waves through inhomogeneous plasma is considered. The results obtained by earlier workers have been suitably modified. The effect of electron collision frequency has been discussed. | | |
| KEYWORDS: Electromagnetic waves, Inhomogeneous plasma | | |

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KEYWORDS: Cerenkov radiation, Test charge, Radiation characteristics

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| 1. ORIGINATING ACTIVITY (Corporate author) Banaras Hindu University Applied Physics Section, Institute of Technology Varanasi 5, India | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE ENERGIZATION OF ELECTRONS IN MAGNETOPLASMA BY WAVE PARTICLE INTERACTION | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) <u>Scientific</u> <u>Interim</u> | | |
| 5. AUTHOR(S) (First name, middle initial, last name) R. N. Singh | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT In this report we have studied the energization of electrons in a magnetoplasma by wave-particle interaction. Depending upon the refractive index of the plasma medium and the field parameters the wave particle interaction exhibits either synchronous or oscillatory behavior. Adopting dipole model of geomagnetic field and various plasma and field parameters the energization of electrons in the ionosphere and magnetosphere has been studied. Detailed computation of energy gain and time of energy oscillation has been carried out. An effort has been made to explain some of the ionospheric and magnetospheric phenomena in the light of these calculations. The role of effective electron collision frequency on the wave particle phenomena has been considered. The problem is reformulated to include the effect of finite collisions. Computation is carried out to display the effect of collisions. Under certain approximate conditions the synchronous and oscillatory behavior of the electron energy has been achieved. Within the frame work of linear theory the behavior of wave particle interaction at harmonics of cyclotron frequency has been studied. It is shown that for refractive index $n = 1$, the interaction at higher harmonics becomes oscillatory. In case of synchronous energization the significance and role of computed results has been discussed in light of measured electron energy by various probes and satellites. The oscillatory energization of electrons produced by wave-particle interaction may play the role of unifying mechanism for various periodic and quasi-periodic phenomena observed in the ionosphere and magnetosphere. | | |

KEYWORDS: Electron energization, Wave particle interaction

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| 3. REPORT TITLE NATURAL GENERATION OF ELECTROMAGNETIC WAVES AND INTERACTION WITH MEDIA | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) R. N. Singh | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT The heating of the electron component of a magnetoplasma due to localized time varying magnetic field perturbations has been studied by solving the relevant Boltzmann transport equation. The variation in electron temperature with pitch angle in chosen plasma models has been studied. The change in electron temperature with perturbation time in each of the plasma models has been shown. It is argued that these results may be helpful in interpreting and analyzing some observed geophysical and astrophysical features. | | |
| KEYWORDS: Magnetoplasma, Magnetic field, Boltzmann transport equation | | |

KEYWORDS: Magnetoplasma, Magnetic field, Boltzmann transport equation

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 b. AUTHORITY (first name, middle initial, last name)
 Gabor Kalman
 Pradip Bakshi

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PH)L. G. Hanscom Field, Bedford, MA. 01730 |
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13. ABSTRACT

A nonlinear fluctuation - dissipation theorem relating quadratic plasma response functions to ternary equilibrium correlations has been derived. Large amplitude non-linear waves in a magnetized plasma with and without collisions have been studied. A computer code for the calculation of the synchrotron-Cherenkov radiation by high energy electrons in a cold plasma has been developed, and detailed numerical results have been obtained. A critical review of solar flare phenomena with a suggestion for the prevailing dynamical processes leading to the acceleration of particles to high energies has been prepared.

KEYWORDS: Energy loss of particles, Razin effect

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| Dept. of Physics Boston College, Chestnut Hill, Massachusetts 02167 | | Unclassified | |
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| 3. REPORT TITLE | | | |
| A MODEL FOR U-SHAPED SOLAR BURST SPECTRA | | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Gabor Kalman Stanford Yukon Pradip Bakshi | | | |
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| 10. DISTRIBUTION STATEMENT A- Approved for public release; distribution unlimited. | | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories, LI), L.G.Hanscom Field, Bedford, Ma. 01730 | |
| 13. ABSTRACT A model, for U-shaped solar bursts based on one single group of moderately relativistic electrons radiating in an ambient cold magnetoplasma is presented. Results of computer calculations are discussed. Suggestions for comparison with observation are made. Speculations about the mechanism of proton acceleration are included. | | | |
| KEYWORDS: Solar bursts, U-shaped spectra, Solar flares | | | |

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| 3. REPORT TITLE ANALYSIS OF ALUMINUM OXIDE FILMS ON SILICON | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Mototaka Kamoshida James W. Mayer Ian V. Mitchell | | |
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| b. PROJECT, Task, Work Unit Nos. 5638-02-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0319 AD747, 019 | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY A.F. Cambridge Research Labs. (LQ) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Aluminum oxide exhibits novel and useful properties as a passivating layer on silicon surfaces. This study was concerned with the properties of hydrolytically grown aluminum oxide films on silicon. The study covered the influence of deposition temperature, of subsequent heat treatment and of anodization. The principal tool of measurement was MeV He ⁺ ion backscattering technique; in addition etch rates were measured and electron diffraction patterns were taken. Aluminum oxide films deposited onto silicon substrates by hydrolysis of AlCl ₃ show marked differences in etch rates, electron diffraction patterns and chlorine content between films grown below 700°C and above 800°C. However, both film types are stoichiometric (oxygen to aluminum ratios of 1.5 ± 0.1). Etch rates and electron diffraction patterns indicated that the properties of films grown at 700°C were not converted to those of the 830°C films even after heat treatment at 900°C in argon. The amount of residual chlorine in low temperature films reduced from 2 at.% to 0.9 at.% after heat treatment but still exceeded that (~ 0.02 at.%) for the film deposited at 830°C. Anodic oxidation of the aluminum oxide films produced oxide layers under the original oxide film. The anodic voltage characteristics exhibited breakdown effects. After breakdown the aluminum oxide became nonuniform and was removed at later stages of anodization. For films deposited at 830°C, once the aluminum oxide film has been removed, the growth of the anodic oxide layer follows that for a bare silicon sample. This offers the possibility of a new selective etching technique since after anodic oxidation the films are easily dissolved with hydrofluoric acid. | | |
| KEYWORDS: Aluminum oxide on silicon, Hydrolytic deposition of Al ₂ O ₃ | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) LAMONT-DOHERTY GEOLOGICAL OBSERVATORY OF COLUMBIA UNIVERSITY PALISADES, NEW YORK 10964 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE REFRACTION PROFILES IN THE VALLEY OF TEN THOUSAND SMOKES, KATMAI, ALASKA. | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific - Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Marc L. Sbar Tosimatu Matumoto | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Bulletin Volcanologique, Vol. 35, No. 2, 1972, pages 335-349. This research was supported by the | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW) L.G. Hanscom Field, Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Advanced Research Projects Agency. | | |
| A refraction study was made in the Valley of Ten Thousand Smokes, Katmai, Alaska to determine the thickness and structure of the 1912 ash flow. The tuff, in general, is composed of a thin surficial layer approximately one half meter thick and a main body that varies from 20 to over 70 meters in the areas surveyed. In most sections, two to three layers were discerned in the main body of the tuff, suggesting that the eruption may have occurred in more than one phase. The greatest thickness of the deposit is in the vicinity of Novarupta. This observation suggests that Novarupta was a major source of the tuff. The estimated volume of the tuff is approximately 3.8 km ³ based on an average thickness of 30 m and an area of 127 km ² . | | |
| KEYWORDS: Aegean Sea, Deep sea cores | | |

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| 2b. GROUP | | |
| 3. REPORT TITLE STRUCTURES IN EARTH NOISE BEYOND TWENTY SECONDS - A WINDOW FOR EARTHQUAKES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific - Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) John Savino Keith McCamy George Hade | | |
| 6. REPORT DATE May 24, 1972 | 7a. TOTAL NO. OF PAGES 36 | 7b. NO. OF REFS 42 |
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| b. Project, Task, Work Unit Nos. | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL -72- 0358 AD746, 798 | |
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| 11. SUPPLEMENTARY NOTES Reprinted from the Bulletin of the Seismological Society of America, Vol. 62, No. 1, pp. 141-176, February 1972 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW) L. G. Hanscom Field | |
| 13. ABSTRACT This research was supported by the Advanced Research Projects Agency. | | |
| <p>The nature of earth noise in the period range 20 to 130 sec has been investigated at the deep (543 m) mine observatory and at a temporary surface installation at Ogdensburg, New Jersey, and its structure, in part, explained. The earth noise spectrum displays a pronounced and stable minimum between 30 and 40 sec, thought to be a transition between the swell-generated microseisms at periods less than 30 sec and nonpropagating ground motion of atmospheric origin at periods greater than 40 sec. We estimate the yearly mean amplitude at 35 sec to be 0.5 $\mu\text{m}/\text{mHz}$, which is 100 times smaller than estimates of the mean amplitude of the 5- to 9-sec microseisms. At periods greater than 40 sec, the noise spectrum rises at 12 to 14 db/oct. Above 30 sec, the earth noise is quite stable, varying by no more than a factor of 3 over a year with higher levels in the winter and lower levels in the summer. By contrast, microseisms with periods less than 20 sec can change by a factor of 10 to 100 in a few days. The shape and amplitude of the earth noise spectrum beyond 20 sec, as well as its attenuation with depth, can be explained by a model of atmospheric pressure cells loading the Earth on equal-area sectors. There is a secondary source of background disturbance—the long-period coda of earthquakes. These higher-mode free oscillations are excited by relatively small events ($m_b = 5.8$) and can dominate the background for as much as 10 per cent of the time during active periods.</p> <p>The structure and stability of the earth noise spectrum at these longer periods allows an important improvement in seismometer design. By shaping the response of the three-component set of long-period high-gain seismographs to resemble the inverse of the mean noise spectrum, the instruments record approximately 10 times as many long-period body and surface waves as the standard long-period seismographs. The elevated signal-to-noise ratio in the 30- to 40-sec window decidedly improves the sensitivity of seismic source-type discriminants.</p> | | |
| KEYWORDS: Structures in earth noise beyond twenty seconds | | |

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| 3. REPORT TITLE GLOBAL TECTONIC IMPLICATIONS OF ANOMALOUS SEISMIC P TRAVELTIMES FROM NUCLEAR EXPLOSION LONGSHOT | | 2b. GROUP |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim. | | |
| 5. AUTHOR(S) (Last name, first name, initial) Klaus H. Jacob | | |
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| 13. ABSTRACT The Defense Advanced Research Projects Agency. | | |
| <p>A recently developed method of three-dimensional seismic-ray tracing is used to reinterpret P-wave traveltimes residuals of the Longshot nuclear explosion on Amchitka, Aleutian Islands, in terms of plate tectonic structures near the source and near the teleseismic stations. The observed pattern of P residuals from Longshot can be explained by a descending lithospheric plate, 80 km thick, that reaches a depth of 250 km beneath the Aleutian arc and has P-wave velocities 7-10% higher than the surrounding mantle. The anomalous high velocity at 100- to 200-km depth indicates that the descending plate at that depth is colder than the surrounding normal mantle by several hundred degrees. The P traveltimes anomaly associated with the dipping plate is eliminated from the total P residuals to obtain new worldwide station residuals. The station residuals are then grouped according to a proposed tectonic code that distinguishes between active zones of plate convergence, divergence, and transcurrent shear, as well as between volcanically active regions and stable oceanic and continental regions. The tectonically grouped station residuals show a strong correlation with various tectonic features. On the average, P arrivals in continental shields are earlier by 1 sec than in younger (but stable) continental and oceanic provinces, and earlier by 2 sec than in active volcanic regions. The station residuals indicate that lateral velocity anomalies within the upper 200 to 250 km of the earth's mantle are commonly associated with tectonic features and that lateral velocity contrasts may in some cases exceed 10% of the average velocity. A new P-residual map for the United States and adjacent Canada is presented.</p> | | |
| KEYWORDS: P traveltimes, Nuclear explosion longshot | | |

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| 3. REPORT TITLE Projects in SOLAR ECLIPSE PREDICTION, IONOSPHERIC REFLECTION PROPERTIES, IONOSPHERIC D-REGION DATA REDUCTION, AND MICROWAVE ACOUSTICS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) SCIENTIFIC, Final, 20 March 1970-19 June 1972 approved 15 Aug 72 | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Kenneth Dieter John V. O'Brien Leo A. Whelan, Jr. | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (SUY) L.G.Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT This report describes analysis and programming projects in astronomy, ionospheric physics, and microwave acoustics. | | |
| KEYWORDS: GRAV, BULK, SEARCH, ECLIPSE | | |

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| 5. AUTHOR(S) (First name, middle initial, last name) Carlos H.J. Calderón Millett G. Morgan | | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Submitted in partial fulfillment of the requirements for a Doctorate in Engineering Sciences, Dartmouth College Hanover, New Hampshire | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT <p>A general study of travelling ionospheric disturbances (T.I.D.'s) has been undertaken. In the theoretical aspect, the gravity-wave resonant mode $k \cdot B_0 = 0$ has been studied and the concept of an ionospheric predictive function has been introduced. In the experimental aspect, the digital data processing portion of the Dartmouth ionosonde network has been brought into operation and seven T.I.D. events have been analyzed with it. The data have been interpreted in light of Hooke's theory and substantial agreement has been found. Further investigation, both theoretical and experimental, of the $k \cdot B_0 = 0$ mode, and the adoption of the iso-height contour presentation of the data rather than the iso-ionic fashion which is conventional in the T.I.D. field, are recommended. Still greater automation in the Dartmouth ionospheric data processing system and the operation of a fourth semi-mobile station, are also recommended.</p> | | |
| KEYWORDS: Ionosphere, Ionospheric sounding, Ionospheric irregularities | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) The Dikewood Corporation 1009 Bradbury Drive, S. E. Albuquerque, New Mexico 87106 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE POLAR CAP BIBLIOGRAPHY WITH ABSTRACTS 2. DISTURBANCE PHENOMENA IN THE POLAR CAP | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) June G. Brenton, Compiler | | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LK) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT DISTURBANCE PHENOMENA IN THE POLAR CAP was compiled by The Dikewood Corporation for the Air Force Cambridge Research Laboratories under Contract No. F19628-70-C-0212 as Volume 2 in a series of bibliographies with abstracts on selected topics in the literature on upper atmospheric phenomena in the inner regions of the polar caps. In general, the references begin with those on activities during the International Geophysical Year and continue with articles published through the year 1971. References are grouped under sixteen subject headings that cover the geomagnetic field, electric field, upper atmospheric current systems, earth currents, magnetic storms, polar and auroral substorms, polar and auroral absorption, magnetosphere, hydromagnetic waves, micropulsations and other pulsations, traveling waves, nuclear-burst effects, and instrumentation and measurement systems for studying these phenomena. | | |
| KEYWORDS: Bibliography with abstracts, Polar cap disturbances | | |

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| 1c. REPORT TITLE HF BACKSCATTER STUDY AT 19.4 MHz THROUGH SUBAURORAL IONOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
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| 13. ABSTRACT Bedford, Massachusetts 01730 | | |
| <p>The aim of this study was to determine the effects of direct scatter from field aligned E- and F-layer irregularities, FAE(E) and FAE(F) respectively, as well as scatter from intense Es clouds on the 19.4 MHz oblique backscatter signal propagating via the F-layer (1F echo). It was found that the direct scatter from field aligned irregularities was weak in nature so that the 1F echo remained unaffected. In fact the presence of the 1F echo was often required to produce FAE(F). The Es clouds which were frequently observed during the summer were also found to be non-blanketing so the Es reflected echo and the 1F echo could exist simultaneously. However, it was found that the 1F echo was a very sensitive function of F-region parameters and was thus affected by both the seasonal and evening anomalies in F2 ionization at these latitudes. In addition, the changing magnetic declination to the east and west of the station was responsible for the asymmetry in the percentage of the time that the 1F echo was observed by the radar in these general directions.</p> <p>Finally, the observed occurrence statistics of FAE(E) and FAE(F) presented in Scientific Report No. 1 are discussed in the context of current theories for the formation of these irregularities.</p> | | |
| KEYWORDS: Backscatter, Aurora, Ionosphere, Radar | | |

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| 3. REPORT TITLE RESEARCH DIRECTED TOWARD MATHEMATICAL ANALYSIS, COMPUTATIONS, AND CURVE PLOTTING IN THE AREA OF MICROWAVE PHYSICS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final. 1 November 1968 - 31 October 1971 | | Approved 5 July 1972 |
| 5. AUTHOR(S) (First name, middle initial, last name) M. Patricia Hagan | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L.G. Hanscom Field |
| 13. ABSTRACT Bedford, Massachusetts 01730 | | |
| <p>In support of problem solutions in the area of microwave physics, mathematical analysis, computations, and curve plotting tasks were performed. Mathematical analyses were carried out to reduce equations, including differential and integral, to a form suitable for numerical solution. Work was oriented toward solutions of problems in the following areas; magneto-acoustic problems, propagation thru a plasma layer, boundary layer problems, resonance phenomena, optimum antenna selection, μ wave antenna design, pulse solutions of electromagnetic scattering problems, and antenna array theory.</p> | | |
| KEYWORDS: Backscatter, Field factors | | |

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| 3. REPORT TITLE INFRASONIC DATA REDUCTION | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) George Ohring | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW), L. G. Hanscom Field, Bedford, Massachusetts 01730 | |
| 13. ABSTRACT A multi-channel prediction-error filter technique is developed for suppressing noise on infrasonic signals. The technique uses samples of noise prior to a signal for deriving a Wiener prediction filter that is used to predict the noise during the first motion of the infrasonic signal. A computer program entitled MAXLKH is written to carry out the filtering technique. Application of the technique to actual infrasonic records indicates that noise has some degree of predictability and, hence, an enhancement of the infrasonic signal results. Further tests are suggested to quantify the amount of noise suppression and to optimize technique parameters such as filter length and prediction span. A discussion of the computer program is included. | | |

KEYWORDS: Infrasonics, Digital filters, Signal/Noise improvement

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KEYWORDS: Gaseous nebulae. H-II regions. Interstellar dust. Light scattering.

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| 3. REPORT TITLE THE DUST CONTINUUM IN THE ORION NEBULA | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) M. Perinotto K. Wurm | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Astron. Nachr., Bd. 293, H. 1-2, 1971, pp 25-31 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PH) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Spectra of the Orion Nebula with along slit (7' and 3' in the sky) and with exposures to the appearance of the visual continuum have been obtained for several positions in the field including, in particular, areas of low surface brightness. The variation of the ratio q= intensity of Balmer emission/intensity of continuous emission is studied. This ratio changes generally rather irregularly along the length of the slit and also from position to position. The spatial variation of q is generally small with the exception of the center of the nebula, where it is particularly high. The variation of the ratio q can be seen with a much higher surface resolution than in the spectra, when comparing monochromatic photographs taken in H _α +[NII] with those taken in the continuum between the stronger emission lines. Within the larger part of the field of the nebula it is possible to distinguish between surface structures typical of the continuous emission and those typical of the hydrogen line emission. The persistence of this differentiation in many areas below the Balmer discontinuity as well as above H _α in the near infrared proves that for the subareas with the stronger continuum the continuous emission must be predominantly scattered light for the entire wavelength range from the ultraviolet to the near infrared. This criterion cannot be applied to areas where there exist no clear differences in the surface structure of the two types of emission. A determination of the Balmer and Paschen discontinuity may possibly lead to a decision. | | |
| KEYWORDS: Gaseous nebulae, H-II regions, Monochromatic photography | | |

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MODIFIED DIPOLES

I. THEORETICAL AND EXPERIMENTAL STUDY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific. Interim

5. AUTHOR(S) (First name, middle initial, last name)

Peter S. Kao

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT

The 'modified dipole' has its origin in the consideration of the general properties of a satellite antenna which bears great resemblance to a dipole modified to incorporate at the center a conducting volume which is used to radiate electromagnetic waves and to house a power supply and radio frequency generators, etc. The object of this research is to pursue a theoretical and experimental exploration of the effects induced by the presence of the conducting volume on the antenna performance, i.e., input characteristics, current distribution along the surfaces of the entire radiating structure and radiation properties.

In Volume I a mathematical model consisting of a perfectly conducting sphere from which project the ends of a thin biconical antenna is chosen to simulate the actual sphere-centered thin dipole. The conical antenna is driven at its junction with the sphere by a rotationally symmetric electric field maintained across the gap by a biconical transmission line excited by the TEM mode. The attractive features of this model include the fact that it has surfaces that permit a simple specification of boundary conditions and, hence, a rigorous formulation for the electromagnetic fields and a shape such that its properties should come reasonably close to those of a modified cylindrical antenna as the cone angle becomes quite small.

The measurements of both input admittances and current distributions on modified dipoles (with either conical or cylindrical antenna projecting from the sphere) are also presented in Volume I. Comparisons were also made between modified conical and cylindrical antennas with the same sphere radii and antenna heights. The radius of the cylindrical antenna is the same as the smaller end of the cone. The fact that the admittance curves for modified cylindrical and conical antennas involve only slight shifts suggests that by introducing an equivalent antenna length that is a little longer than the actual physical length of the conical antenna a good approximation is obtained for the cylindrical antenna.

An infinite set of algebraic equations was solved numerically in Volume II for small cone angles. Comparisons were made between the modified conical antenna and its limiting biconical antenna which provides both an extrapolatory numerical check for the modified conical antenna with shrinking central sphere and an understanding of the underlying physical phenomena. Theoretical and experimental results are in very good agreement.

KEYWORDS: Modified dipoles, Conical antennas, Cylindrical antennas

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3. REPORT TITLE

MODIFIED DIPOLES
II. NUMERICAL SOLUTIONS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT

The 'modified dipole' has its origin in the consideration of the general properties of a satellite antenna which bears great resemblance to a dipole modified to incorporate at the center a conducting volume which is used to radiate electromagnetic waves and to house a power supply and radio frequency generators, etc. The object of this research is to pursue a theoretical and experimental exploration of the effects induced by the presence of the conducting volume on the antenna performance, i.e., input characteristics, current distribution along the surfaces of the entire radiating structure and radiation properties.

In Volume I a mathematical model consisting of perfectly conducting sphere from which project the ends of a thin biconical antenna is chosen to simulate the actual sphere-centered thin dipole. The conical antenna is driven at its junction with the sphere by a rotationally symmetric electric field maintained across the gap by a biconical transmission line excited by the TEM mode. The attractive features of this model include the fact that it has surfaces that permit a simple specification of boundary conditions and, hence, a rigorous formulation for the electromagnetic fields and a shape such that its properties should come reasonably close to those of a modified cylindrical antenna as the cone angle becomes quite small.

The measurements of both input admittances and current distributions on modified dipoles (with either conical or cylindrical antenna projecting from the sphere) are also presented in Volume I. Comparisons were also made between modified conical and cylindrical antennas with the same sphere radii and antenna heights. The radius of the cylindrical antenna is the same as the smaller end of the cone. The fact that the admittance curves for modified cylindrical and conical antennas involve only slight shifts suggests that by introducing an equivalent antenna length that is a little longer than the actual physical length of the conical antenna a good approximation is obtained for the cylindrical antenna.

An infinite set of algebraic equations was solved numerically in Volume II for small cone angles. Comparisons were made between the modified conical antenna and its limiting biconical antenna which provides both an extrapolatory numerical check for the modified conical antenna with shrinking central sphere and an understanding of the underlying physical phenomena. Theoretical and experimental results are in very good agreement.

KEYWORDS: Modified dipoles, Conical antennas, Cylindrical antennas

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| 3. REPORT TITLE INVESTIGATION OF CHARACTERISTICS AND PRACTICAL IMPLEMENTATION OF ARBITRARILY POLARIZED RADIATORS IN SLOT ARRAY |
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4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific. Final., 1 January 1970 through 15 April 1972 Approved 24 May 1972

5. AUTHOR(S) (First name, middle initial, last name)

| | |
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| James S. Ajioka | Raymond Tang |
| Dick M. Joe | Nam S. Wong |

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L.G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT

The feasibility of the method of obtaining arbitrary polarization in both one and two-dimensional waveguide slot arrays has been demonstrated. The arbitrarily polarized radiating element consists of a pair of cross slots which are cut in the sidewall of a bifurcated rectangular waveguide. Vertical and horizontal polarizations are excited by the sum and difference modes, respectively, in the bifurcated waveguide. By superimposing the sum and difference modes in the proper amplitude and phase, any arbitrary polarization can be synthesized.

A 2-D array consisting of 8 linear arrays, ferrite phase shifters for scanning, and a feed network for power distribution and polarization control was constructed. Experimental results indicated that good radiation performance for all polarizations is obtained for this type of antenna. In linear polarization operation, the cross polarization is about -25 dB. For circular polarization, the axial ratio is about 1.0 dB. The polarization is selected by controlling a phase shifter. Close in sidelobes of better than 20 dB have been obtained for all polarizations. The above performance characteristics were obtained over a scan range of $\pm 20^\circ$. The size of the experimental array limits the performance demonstration to a larger scan angle.

KEYWORDS: Arbitrarily polarized antenna, Cross slot radiators

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| 1. ORIGINATING ACTIVITY (Corporate author) PR Conselho Nacional de Pesquisas Instituto de Pesquisas Espaciais INPE Sao Jose dos Campos - SP - Brasil | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE GEOMAGNETIC MEASUREMENTS AT SAO JOSE DOS CAMPOS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final, July 1967 to May 1970. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Fernando de Mendonca | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (OP) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The scalar value of the total intensity of the earth's magnetic field was recorded for portions of the intervals from July 1967 through May 1970. The values were recorded at Sao Jose Dos Campos, Brazil, a site located within the area where the total intensity is at a world-wide minimum value. The data obtained from an alkali vapor magnetometer, included the hourly mean of the total field per day, the daily mean, the range and an index based on the root mean square of the hourly deviations from the average field of the day. | | |
| KEYWORDS: Magnetometer, magnetic field data, Magnetic observatory | | |

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| 3. REPORT TITLE OBSERVATIONS OF BEACON TRANSMISSIONS FROM SATELLITES INTELSAT 2F-1 AND 2F-2 |
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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim. |
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| 5. AUTHOR(S) (First name, middle initial, last name) Ludwik Liszka |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT The

In the present report beacon transmissions from the semi-geostationary satellite Intelsat 2F-1 and the geostationary satellite Intelsat 2F-2 are used for studies of the high latitude ionosphere. Summar-daytime latitudinal variations of the electron content, geomagnetic storm effects and unusual propagation effects in the subauroral zone ionosphere are studied.

KEYWORDS: Geostationary satellites, Polarization variations

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| 2b. GROUP | | |
| 3. REPORT TITLE SMALL ROCKET WIRE DEPLOYMENT FOR LIGHTNING TRIGGERING AND HAZARD REDUCTION | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific, Final: (July 1970 - December 1971), Approved: (May 24, 1972) | | |
| 5. AUTHOR(S) (Last name, first name, initial) James R. Stahmann | | |
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| 11. SUPPLEMENTARY NOTES This research was supported by the AFCRL Laboratory Director's Fund. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Labs (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT For triggering or diverting natural lightning strokes, the electrical properties of a large rocket motor and its exhaust plume were simulated by deploying long wires from small rockets. A wire length of between one and two thousand feet should adequately simulate the conductive effects of an Apollo vehicle. Various small rocket motors were considered, and the Little John was selected for study in an experimental program. The wire was deployed from an on-board package. After estimating the forces acting on the wire, a computer program for simulating a flight was developed. The experimental results gave a measure of the very difficult to estimate air drag coefficient as about three times that estimated earlier. The entire 2,500 foot length of wire in one package was successfully deployed into the rocket trajectory. Although this wire was not towed by the rocket, such wires could be deployed into a selected part of the trajectory. In another deployment experiment, evidence indicated that a wire length of 1,200 feet was successfully deployed and then towed for a short time by the rocket. While the Little John wire package could be improved for wire towing, deploying conductors into the trajectory by this and other methods would also trigger lightning for a longer effective time, with a significant reduction in cost. KEYWORDS: Lightning, Lightning triggering, Lightning interception | | |

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| 3. REPORT TITLE DIGITAL IONOSONDE FOR MONITORING THE IONOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final. 28 March 1969-31 July 1971 | | Approved 25 Feb. 1972 |
| 5. AUTHOR(S) (First name, middle initial, last name) Klaus Bibl Joseph A. Patenaude Bodo W. Reinisch | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Many years experience in ionospheric physics as well as design and operation of ionospheric sounders were the basis for creation of the Digisonde 128. By implementing the latest achievements in state of the art technology and recent advancements in solid state analog components and digital arrays, a technically sophisticated ionosonde has been realized. Although the main feature of the Digisonde 128 is the continuous monitoring of the ionosphere by vertical pulse sounding in a large frequency range, it has many features which make it the most versatile instrument of its kind. Continuous recording of ionospheric absorption at many frequencies makes this sounder a unique geophysical tool. This report supersedes AFCRL report No. AFCRL-71-0001 entitled "Design, Develop and Fabricate an Ionospheric Sounding System Using Digital Phase-Coherent Integrating Techniques" dated December 1970 (Contract F19628-68-C-0267). | | |
| KEYWORDS: Pulse ionosounder, Coherent detection, Digital integration | | |

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| 3. REPORT TITLE DESIGN AND FABRICATION OF SOUNDING ROCKET PAYLOADS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final. 1 January 1970 - 31 May 1972 | | Approved: 5 June 1972 |
| 5. AUTHOR(S) (First name, middle initial, last name) Richard E. Kenyon | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LC) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT This report reviews work accomplished from February 1970 through May 1972 on the design, integration and launch support of high altitude sounding rocket payloads. Each payload undertaken or completed is described in a brief synopsis stating: the basic experimental objectives; support electronics and instrumentation supplies; and launch support results. Other material presented includes: monitor circuit techniques; description of a NiCad battery charger; results of tests on NiCad batteries; discussions of: a squib checker; a door eject mechanism; a payload separation mechanism; and a despin mechanism. | | |
| KEYWORDS: Payloads, Rockets, Design, Sounding rockets, Battery charger | | |

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3. REPORT TITLE

EXPERIMENT ON CROSS RELAXATION IN CO₂

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

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5. AUTHOR(S) (First name, middle initial, last name)

Harold Granek
Charles Freed
Hermann A. Haus

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12. SPONSORING MILITARY ACTIVITY

Air Force Cambridge Research
Laboratories (OP)
L.G. Hanscom Field
Bedford, Massachusetts 01730

13. ABSTRACT The details of the hold-burning process are studied experimentally and theoretically in a Doppler-broadened gain or absorption line in pure CO₂ and in CO₂-N₂ mixtures contained in a test cell. The change of absorption or gain of the test cell when irradiated by a saturating laser in a P transition is probed with another laser operating in one of many R transitions. In this way one may determine the rate of velocity cross relaxation with a single rotational-vibrational level and the rate of cross relaxation between different rotational levels of the upper and lower vibrational states. When the probing laser shares a common upper or lower level with the saturating laser, a pip is observed in the differential absorption or gain profile at total pressures of less than 0.5 torr. At higher pressures the relaxation across the velocity profile eliminates the pip. An analysis is presented of the population distribution in the multilevel system of CO₂. Three of the relaxation rates (describing the relaxation across the velocity profile of a single level, the relaxation among rotational levels of the vibrational state, and the phenomenological relaxation rate of entry into and departure from the upper and lower vibrational states) are determined. The last of the three rates is found to be dominated by diffusion at the pressures used in the experiment.

KEYWORDS: Cross relaxation in CO₂, Doppler broadening in CO₂

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3. REPORT TITLE

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5. AUTHOR(S) (First name, middle initial, last name)

W. P. Allis and H. A. Haus
E. E. Stark, Jr., and P. W. Hoff
W. A. Stiehl

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12. SPONSORING MILITARY ACTIVITY Air Force

Cambridge Research Laboratories(OP)
L.G. Hanscom Field, Bedford, Mass. 01730

13. ABSTRACT

- A. This report studies electron distribution and lasing efficiency of a diatomic gas laser. A model is presented of a diatomic laser gas that has the level structure of a harmonic oscillator, and exchanges energy via vibrational-translational collisions with a background gas. The electrons pumping the lasing molecules are described by a distribution function in velocity space obeying a differential equation that can be solved in closed form under certain simplifying assumptions. The excitation of the diatomic molecules is related to the electron distribution. We determine a limit on the efficiency of conversion between electrical energy and optical energy.
- B. Measurements of the V-V relaxation rate in the asymmetric stretch mode of CO₂ are reported. This study was made in a TEA CO₂ amplifier, using unusual pulse amplification results.
- C. This report deals with measurement of the spectrum of a TEA CO₂ laser, and reports what we believe to be the first measurements of the dynamic frequency of individual TEA laser pulses.

KEYWORDS: CO₂ laser, Diatomic lasers, Electrodynamics of media

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| | | 2b. GROUP |
| 3. REPORT TITLE PHOTOEMISSION STUDIES WITH SEVERAL INDEPENDENT PARAMETERS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final December 1968 - May 1972 Approved July 72 | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Richard Y. Koyama | | |
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| 11. SUPPLEMENTARY NOTES This research was supported in part by the Defense Nuclear Agency | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LQ) L. G. Hanscom Field Bedford, Mass. 01730 | |
| 13. ABSTRACT This report summarizes the photoemission work performed at the NBS Synchrotron Ultraviolet Radiation Facility (NBS-SURF). Important aspects and innovations of the experimental hardware are described. The primary results center on the dependence of the electron energy distributions from evaporated gold films on all independent parameters available in the experiment; namely: energy, incidence angle and polarization of photons, and the emission angle of electrons. Work on aluminum oxide films is also discussed. | | |
| KEY WORDS: Photoemission, Energy distribution, Gold | | |

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| 3. REPORT TITLE RESEARCH AND DEVELOPMENT OF ANTENNAS FOR ROCKET AND SATELLITE DATA TRANSMISSION | | 2b. GROUP |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final 13 January 1969 - 13 January 1972 | | Approved: 18 May 1972 |
| 5. AUTHOR(S) (First name, middle initial, last name) A. Waterman Dennis G. Henry. | | |
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| 11. SUPPLEMENTARY NOTES This research was supported by the Laboratory Directors Fund | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LC) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The Physical Science Laboratory, New Mexico State University has conducted research and development studies of antenna designs under contract to the Air Force Cambridge Research Laboratories. The studies included the development of telemetry and beacon antenna designs for research rockets and satellites as directed by the contracting officer. The most significant development was the design of a stripline integrated array for operation in the 2.2 GHz to 2.3 GHz S-band telemetry range, and the 5.5 GHz or 5.7 GHz C-band Beacon range. Summaries of the work performed are presented in this report. | | |
| KEYWORDS: Antennas, S-band, Research rockets, Satellites | | |

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| 3. REPORT TITLE ANTENNA PATTERN SYNTHESIS | | |
| 4. DESCRIPTIVE NOTES (Type of report and, inclusive dates) Scientific Final September 1969-May 1972 Approved 10 July 1972 | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Donald R. Rhodes | | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The significance of the results obtained and published on this contract in seven Scientific Reports is summarized briefly. | | |
| KEYWORDS: Antenna synthesis | | |

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| 13. ABSTRACT The original Taylor distribution was designed to terminate abruptly in a pedestal ($\alpha=0$) at its edges. It has been found recently, however, that a pedestal cannot be realized exactly in either the E or H planes, nor even approximately in the H plane. A new distribution is derived here that produces a Taylor pattern of order $\alpha=1$ and, hence, that vanishes linearly at the edges. This edge behavior can be realized exactly in the E plane and can be approximated as closely as desired in the H plane. All practical differences in operating performance between the two distributions have been found to be negligible. | |
| KEYWORDS: Antenna synthesis, Taylor distribution | |

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| 3. REPORT TITLE ON A CLASS OF OPTIMUM APERTURE DISTRIBUTIONS FOR PATTERN SHAPING | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) Donald R. Rhodes | | |
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| 13. ABSTRACT A class of optimum aperture distributions that gives the best mean-square approximation with weight factor $(1-\eta^2)^\alpha$ to any given pattern space factor for an arbitrarily prescribed value of a generalized superdirective ratio γ_α is derived for all $\alpha > -1$. For $\alpha=0$ the parameter γ_α becomes Taylor's superdirective ratio γ and the γ_α -constrained solution reduces simply to a γ -constrained solution published earlier. But for $\alpha=-\frac{1}{2}, \frac{1}{2}$ or 1 the solution becomes the best, or near best, Q-constrained solution in the sense of least radiated power in the error pattern for the case of E-plane strip source antennas or of H-plane strip or line-source antennas, respectively. Thus, for strip or line source antennas the new solution possesses an important physical interpretation that the earlier solution did not. | | |
| KEYWORDS: Antenna synthesis. | | |

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| 4. DESCRIPTIVE NOTES (Type of report and, inclusive date) Scientific. Interim. |
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| 13. ABSTRACT Exact formulas are derived for the quality factor Q of strip and line source antennas. Contrary to popular opinion, none of them is equal to Taylor's superdirective ratio γ or to $\gamma-1$. But in the case of E-plane strip sources (the complement of the type of strip source treated by Woodward and Lawson) the value of Q is precisely equal to $\gamma_{\alpha}^{-1/2}-1$, where γ_{α}^{β} is a generalized supredirectivity ratio that reduces to Taylor's γ when the edge exponent α and the pattern weighting exponent β are both zero. In the case of H-plane strip sources the value of Q is approximately equal to $\gamma_{\alpha}^{1/2}-1$, and for H-plane line sources of vanishing width a it is approximately equal to $[(2/\pi) \ln (2.516\lambda/\pi a)]\gamma_{\alpha}^{-1}$. |
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KEYWORDS: Antenna Q

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| 3. REPORT TITLE TWO FORTRAN IV COMPUTER PROGRAMS FOR THE GENERAL COMBINATION OF SATELLITE AND GRAVITY DATA FOR POSITION AND GRAVITY FIELD DETERMINATIONS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) S. Gopalapillai Pentti Karki Richard Rapp | | |
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| 8c. PROJECT NO task, work, unit nos. 7600-02, 04-01 | | 8d. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0142 AD746, 305 |
| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW) L. G. Hanscom Field | |
| 13. ABSTRACT Bedford, Massachusetts 01730 | | |
| Previous work on the general combination procedure has been extended to include datum rotation and datum scale parameters. The new equations have been incorporated into two computer programs that are described in the report. The first program incorporates satellite derived station coordinates and data from gravimetrically oriented stations to find a consistent set of datum parameters, geocentric coordinates of various stations, and an equatorial radius. This program is designed to handle a various number of unknowns. One such dimension would allow for 35 satellite derived stations, 25 astro-gravimetrically stations, and 10 datums. In the second program, potential coefficients are added as unknowns and deflections of the vertical and height anomaly information is directly input to the program. In this program, in addition to the unknowns described in the first program, a total of 330 potential coefficients or a set complete to n = 17 may be found. This latter program incorporates a set of 2592 5° mean anomalies, and yields an adjusted set of these anomalies that are consistent with the adjusted potential coefficients. | | |
| KEYWORDS: Geodesy, Gravity field, Station positions | | |

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| 3. REPORT TITLE THE EXTERNAL GRAVITY POTENTIAL ON THE EARTH AND GRAVITY DEPENDENT GEODETIC PARAMETERS |
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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final, January 1, 1969 to December 31, 1971 | Approved May 2, 1972 |
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5. AUTHOR(S) (First name, middle initial, last name)

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13. ABSTRACT

This is a final report on research done under Contract AF19628-69-C-0127. The research reported in twenty-two scientific reports, numerous scientific papers, internal memorandums, dissertations and theses has been summarized and evaluated, keeping in mind the objectives of the Contract. Continuation of the work in the subject matter is discussed.

KEYWORDS: Earth models, Deflection of the vertical, Gravity field

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| 3. REPORT TITLE FILAMENTARY TRACKS FORMED IN TRANSPARENT OPTICAL GLASS BY LASER BEAM SELF FOCUSING. III. FILAMENT FORMATION | | |
| 4. DESCRIPTIVE NOTES <i>(Type of report and inclusive dates)</i> Scientific Interim | | |
| 5. AUTHOR(S) <i>(First name, middle initial, last name)</i> Edwin L. Kerr | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Physical Review A, Vol. 6, No. 3, pp 1162-1171, September 1972 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (OP) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Electrostrictive laser beam self focusing was simulated on a digital computer according to my previous derivation. The results show the beam focusing itself into a long thin filament a few wave lengths of light in radius, propagating with nearly constant radius up to several centimeters, and diverging again. The filament radius decreases throughout the pulse. It also decreases with increasing pulse power. The filament length varies approximately as the square root of the input power above threshold. Growth up stream and down stream is initially at 10^7 to 10^8 cm/sec. The maximum extent is reached before the peak of the incident laser pulse, but the maximum intensity is achieved after the peak. Computer "streak diagrams" are very similar to recent streak photographs of track formation. The filamentary theory is more attractive than the moving focus theory presented previously as no rapidly responding (fast) self-focusing mechanism is required to explain track-growth spurts with rapidly temporally modulated pulses. The trapping threshold for an arbitrary combination of fast and electrostrictive self-focusing mechanisms is presented. | | |
| KEYWORDS: Glass damage, Track formation, Filament formation | | |

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5. AUTHOR(S) (First name, middle initial, last name)

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13. ABSTRACT Small craters are formed when a self-focused laser filament reaches an end surface of a glass sample. These may be formed by the electric surface stress. The normal pressure is typically 10^7 N.m^{-2} (1500 lbf/in^2) at threshold pulse energies for a track radius of 2.5 um.

KEYWORDS: Glass damage, Laser damage, Electric stress

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| 3. REPORT TITLE SOLUTION NEAR THE WAVEFRONT OF TRANSIENT FIELDS IN INHOMOGENEOUS DISPERSIVE MEDIA | | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Leopold B. Felsen | | | |
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| 11. SUPPLEMENTARY NOTES IEEE Transactions on Antennas and Propagation, vol. AP-20, No. 2, March 1972, pp. 219-221 | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Labs.(LZ) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT <p>Uniform asymptotic representations, valid in the vicinity of the wavefront, are derived for transient fields propagating in an inhomogeneous dispersive medium. When the space-time ray equations for these fields can be solved explicitly, the uniform representations yield explicit expressions in the space-time variables; otherwise, the representations involve a parameter which can, however, be eliminated under more restrictive conditions. The results are applied to plane pulse propagation in a plane stratified plasma with exponential variation of electron density, for which the space-time ray equations can be solved in closed form; in this case, the asymptotic representation is found to yield the known exact solution.</p> | | | |
| KEYWORDS: Propagation, Wavefronts, Transient fields, Dispersive media | | | |

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| 2b. GROUP | | |
| 3. REPORT TITLE SPONTANEOUS EMISSION FROM A DRIVEN DOPPLER LINE | | |
| 4. DESCRIPTIVE NOTES (Type of report and Inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Maurice C. Newstein | | |
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| 11. SUPPLEMENTARY NOTES IEEE Journal of Quantum Electronics Vol. QE-8, No. 2, February 1972 | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Labs. L. G. Hanscom Field (OP) Bedford, Massachusetts 01730 |
| 13. ABSTRACT <p>A previously developed theory of spontaneous emission from driven systems has been applied to the case of a Doppler broadened gas of two level atoms radiating into free space. The power spectrum of those photons radiated nearly parallel to the propagation vector of the driving field is predicted to differ from that of the undriven system. The case of zero attenuation coefficient (population equality in the two resonance levels) and the driving field tuned to the center of the Doppler line, is investigated in particular. When the saturation parameter is large there is strong suppression, in an interval about the central frequency comparable to the saturated width, of the spontaneous emission whose spectral components are phased for amplitude modulation relative to the driving field. An amount of power equal to that suppressed, but with spectral components phased for phase modulation relative to the driving field, is radiated in an interval about the central frequency comparable to the homogeneous width.</p> | | |
| KEYWORDS: Lasers, Coherence, Spontaneous emission | | |

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| 3. REPORT TITLE THE MEAN GREEN'S FUNCTION: A NONLINEAR APPROXIMATION | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Shalom Rosenbaum | | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited | | |
| 11. SUPPLEMENTARY NOTES Radio Science, Vol. 6, No. 3, pp. 379-386, March 1971 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories L.G. Hanscom Field (LZ) Bedford, Massachusetts 01730 | |
| 13. ABSTRACT In this paper, we examine the behavior of the coherent Green's function in a randomly fluctuating, unbounded, and statistically homogeneous medium. The starting point of the analysis is a "nonlinear" approximation of the Dyson equation which has been pointed out by several investigators. Although exact solutions seem out of reach, owing to the inherent complexity of the problem, approximate solutions that are applicable in the limits of small and large-scale fluctuations can be obtained. The large-scale fluctuations are emphasized in this paper. Both one- and three-dimensional fluctuations are considered, and explicit calculations are made for the case in which an exponential correlation governs the refractive-index fluctuations. The solutions obtained are investigated in various limiting cases for which closed-form results are derived. | | |
| KEYWORDS: Nonlinear Green's functions, Fluctuating media | | |

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| 3. REPORT TITLE THE EFFECT OF A DIPPING LAYER ON P-WAVE TRANSMISSION. | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific - Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Albert M. Rogers, Jr. Carl Kisslinger | | |
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| 11. SUPPLEMENTARY NOTES Reprinted from Bull. Seism. Soc. Am., 62, No. 1, pp 301-324, Feb. 1972. This research was supported by Advanced Research Projects Agency. | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT A ray-theory development of the effect of dip on P-wave transmission through a single layer over a half-space permits an assessment of errors due to dip in estimates of crustal thickness from observed P-wave spectral properties using transmission coefficients for a nondipping interface. The possibility of simultaneously deriving depth and dip from such observations is also shown. The theory has been tested by experiments in a two-dimensional laboratory model and applied to observations of deep South American earthquakes at small epicentral distances. Theory and laboratory results show that errors in depth reflecting dip are less than 5 per cent for dips up to 25°. Dip can be estimated by matching observed and theoretical curves, once a velocity contrast has been fixed independently. A curve-matching technique for objectively selecting the best match has been developed. A variation of parameter study shows that changes in velocity contrast do not change the shape of the crustal transfer function, but peak-to-trough differences increase with increasing velocity contrast. A change in depth of a dipping layer produces no change in the crustal transfer function plotted in dimensionless frequency. The transfer function changes with dip more rapidly for waves incident downdip. If the data window is long enough to include P and PPP (three P legs in the layer), the depth determination is not sensitive to window length, but dip determination is not possible for short windows. The data for Antofagasta permit one of two solutions, a crust either 46.1 or 56.7 km thick, with the M discontinuity dipping 5° east, with the 46.1 km thickness preferred. This result agrees well with refraction results of others. A less firm result for Napa is crust 74.7 km thick, with dip 15° to the southeast. | | |
| KEY WORDS: P-waves, Transmission coefficients, Dipping layer | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Saint Louis University Department of Earth and Atmospheric Sciences St. Louis, Missouri 63156 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | | 2b. GROUP |
| 3. REPORT TITLE THE AMPLITUDES OF TELESEISMIC P WAVES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific - Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Otto W. Nuttli | | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from Bull. Seism. Soc. Am., 62, No. 1 pp. 343-356, Feb. 1972. This research was supported by Advanced Research Projects Agency. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Amplitudes of P waves recorded by long-period seismographs for nuclear explosions in Novaya Zemlya, the Nevada Test Site, and Amchitka Island yield a new body-wave magnitude calibration function for teleseismic distances. At some distances, it differs from the Gutenberg-Richter (1956) function by as much as 0.4 magnitude units. A comparison of short- and long-period body-wave magnitudes for the 1966 Novaya Zemlya event indicates that anelastic attenuation of P waves is greater in the upper than in the lower mantle, but, for waves with periods of 1 sec or greater, the effect of anelastic attenuation on the amplitudes is less than that of geometric spreading. The amplitude data hint at the existence of a second-order velocity discontinuity in the lower mantle at a depth of about 2300 km. | | |
| KEYWORDS: P-waves, Amplitudes, Body wave magnitude | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Saint Louis University Department of Earth & Atmospheric Sciences Saint Louis, Missouri 63156 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE FAULT MOTION AND SPATIALLY BOUNDED CHARACTER OF EARTHQUAKES IN AMCHITKA PASS AND THE DELAROF ISLANDS. | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) William Stauder | | |
| 6. REPORT DATE May 1972 | 7a. TOTAL NO. OF PAGES 9 | 7b. NO. OF REFS 20 |
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| 11. SUPPLEMENTARY NOTES Reprinted from Journal of Geophysical Research, Vol. 77, No. 11, 2072-2080, Apr. 10, 1972. This research was supported by Advanced Research Projects Agency | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT During the period from May 1969 to March 1970, seven moderate earthquakes occurred in the Delarof-Andreanof Island region. The focal mechanisms of these earthquakes correspond to the motion that would be expected on the basis of plate tectonics. Of more particular significance, the motion in one of these shocks, located at intermediate depth in the Benioff zone, indicates horizontal tension parallel to the plate, corresponding to lateral extension as the plate descends under an arcuate structure convex to the plate motion. The spatial and temporal relation of these earthquakes and of their aftershock sequences to the over-all activity of the arc and particularly to the seismicity of the Rat Islands during this period supports the hypothesis that the Aleutian Islands are active by independent blocks and that the boundaries of these blocks are permanent features. | | |
| KEYWORDS: Amchitka Pass, Focal mechanism, Subduction | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Sanders Associates, Inc. Electro-Optics Division 95 Canal Street, Nashua, New Hampshire 03060 | 2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED | 2b. GROUP |
| 3. REPORT TITLE APPLICATIONS EVALUATION OF MATERIALS 5067 (YHG) R1 | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final, March 1, 1970 - August 31, 1971 | Approved: 24 Apr. 72 | |
| 5. AUTHOR(S) (First name, middle initial, last name) Charles S. Naiman Robert C. Folweiler Paul F. Murphy | William C. Fricke Evan P. Chicklis John H. Hopps | |
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| b. PROJECT <input checked="" type="checkbox"/> Task, Work Unit Nos. 5621-07, 08-01; 5620-08-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0204 AD743, 940 | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (L0) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT | | |
| <p>This report covers a range of material and device development programs as outlined below.</p> <p>I Evaluation of Spinel Powders as Diffuse Reflecting/Fluorescing Laser Cavity Material</p> <p>This study was undertaken to improve the efficiency of Nd³⁺ doped lasers. Powders were prepared by Air Force Cambridge Research Laboratory of spinel (MgO · Al₂O₃) doped with Cr³⁺. Chromium in spinel absorbs in the blue-green region and is known to fluoresce in the region of the pump bands of Nd³⁺. The lifetime was found to be long, ~2 msec, and the fluorescent conversion efficiency low. Laser evaluation tests were performed to compare the powders, with no detectable improvement.</p> <p>II Uses of Ge₂O₃</p> <p>Single crystal GeO₂ grown at AFCRL in the tetragonal form was studied for potential application as (1) electronic material for junction devices, (2) substrate for Ge devices, and (3) polarizer for optical systems.</p> <p>The material as a polarizer has good potential for application because of a reasonable birefringence and longer wavelength transmission. The wide band gap of GeO₂ may permit application as a high temperature semiconductor. Additional experimentation is required to determine the usefulness. The possibility of surface reduction to form the Ge film for devices, or deposition of it by conventional techniques, should be examined.</p> <p>III Medium Gain, High Energy Storage Nd³⁺ Laser Materials</p> <p>A laser host with properties intermediate between Nd³⁺:YAG and Nd³⁺:Glass would fill the gap between these two laser hosts, thereby providing both high peak power and high average power, filling a military need in such areas as illuminators. A survey of materials indicated that some of the germanate based materials have very attractive properties.</p> <p>IV Experimental Evaluation of Schottky Barrier Detectors</p> <p>The Schottky barrier hot electron detectors fabricated by AFCRL were tested for their response to fast risetime pulses. The units demonstrated the fast response anticipated.</p> | | |
| KEYWORDS: Laser cavities, Diffuse reflectors, Doped spinel, Germanium dioxide | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Smithsonian Astrophysical Observatory 60 Garden Street Cambridge, Massachusetts 02138 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| 2b. GROUP | | |
| 3. REPORT TITLE Laser Predictions of Geos 1 and Geos 2 | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific, Final, 1 December 1970 – 30 November 1971 Approved 6 June 72 | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Robert W. Martin | | |
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| b. Project, Task, Work Unit Nos. c. 7600-03-01 DOD Element 62101F | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-71-0611 AD745, 455 | |
| d. DOD Subelement 687600 | | |
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| 11. SUPPLEMENTARY NOTES Tech, Other | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LW) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The report documents the work performed by the Smithsonian Astrophysical Observatory in supplying laser predictions for the Air Force Cambridge Research Laboratories. An average of 3500 predictions per week was generated for satellites Geos 1 and Geos 2 for a site at L.G. Hanscom Field, Bedford, Mass. Frequency of prediction was every 10 sec for every available pass over the station. | | |
| KEYWORDS: Laser, Predictions, Satellite, Geos 1, Geos 2 | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Stevens Institute of Technology Department of Mechanical Engineering Castle Point Station, Hoboken, N.J. 07030 | | 1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED |
| | | 1b. GROUP |
| 3. REPORT TITLE A COMPENDIUM OF THE MECHANICAL PROPERTIES OF POLYETHYLENE BALLOON FILMS | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Harold Alexander Dan Weissmann | | |
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| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES This research was partially supported by the Defense Nuclear Agency. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LC) L.G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT During the process of establishing testing procedures that can be used in determining the suitability of various polyethylene films for balloon use and in subsequent testing of various balloon and balloon candidate materials much information has been collected on the mechanical properties of these films and the structural factors affecting them. This information includes the results of an extensive low temperature biaxial failure test sequence, a detailed discussion of the relationship of structure to mechanical properties and mechanical behavior, experimentation for the establishment of a failure criterion for balloon films the development of an approximate constitutive theory for polyethylene balloon films and a discussion of the effect of orientation balance on mechanical properties. It is the purpose of this report to place this information at the disposal of the ballooning community to aid in the production of future balloon films and in the design of future balloon systems. | | |
| KEYWORDS: Balloon, High altitude, Plastic films, Mechanical properties | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Stevens Institute of Technology Department of Mechanical Engineering Hoboken, New Jersey 07030 | 2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED |
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5. AUTHOR(S) (First name, middle initial, last name)

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10. DISTRIBUTION STATEMENT

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| 11. SUPPLEMENTARY NOTES This research was partially supported by the Defense Nuclear Agency. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LC) L.G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT

In September, 1968, the Laboratory for Balloon Technology was established at Stevens Institute of Technology under the sponsorship of the Air Force Cambridge Research Laboratories. This report contains a description of the facilities of the laboratory and explains the philosophy of investigation of balloon materials and structures that inspired its establishment. The activities of the first three years of the existence of this laboratory are summarized. The major accomplishments including investigations into the mechanical properties of polyethylene balloon films, the development of specifications for qualification and acceptance of polyethylene film for balloon use, evaluation of fiber reinforced films used in high altitude balloons and evaluation of new plastic films for balloon use are outlined with references to appropriate scientific reports where the details are presented. Where this report constitutes the first formal reporting of results the details are given.

KEYWORDS: Balloon, High altitude, Plastic films, Mechanical properties

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| 1. ORIGINATING ACTIVITY (Corporate author) The Queen's University Belfast BT7 1NN Northern Ireland, U.K. | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE LASER PICOSECOND PULSE GENERATION AND MEASUREMENT | | |
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| 5. AUTHOR(S) (First name, middle initial, last name) D.J. Bradley | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Labs/OPL L.G. Hanscom Field Bedford, Mass 01730 | |
| 13. ABSTRACT Detailed studies of ruby laser mode-locking with saturable absorbers have been carried out. Oscillation in pure, low order transverse modes has been achieved and improvements in pulse duration and general reproducibility have been obtained by employing DDCI in optical contact with a laser cavity mirror. By varying the length of the saturable absorber it was possible to change the mode-locked pulse durations and to produce pulses of durations as short as 10 picoseconds. Anomalous quenching effects of two-photon fluorescence patterns in Rhodamine 6G and DPA have been extensively studied and explained as arising from fluorescence quenching due to single-photon excitation to higher electronic levels combined with stimulated emission from the first excited electronic singlet level. Anomalous results in the measurement of picosecond pulse durations by the two-photon fluorescence track technique have thus been clarified. Transverse mode-locking of the ruby laser has also been observed in a confocal cavity which also produced simultaneous transverse and longitudinal mode-locking. Travelling wave amplification of the pulse trains in DDCI and DTDCI permitted the changing of the pulse optical frequency to longer wavelengths. Finally the saturable action of phthalocyanine dyes in the vapour phase has been studied and successful Q-switching of the ruby laser employing phthalocyanine vapour has been accomplished. KEYWORDS: Laser, Mode-locked laser, Picosecond laser pulse | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) The University Department of Chemistry Southampton, S09, 5NH, England | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE APPLICATION OF EMISSION SPECTROSCOPY TO CHEMICAL KINETIC SYSTEMS |
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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final, 1 February 1969 to 31 January 1972 |
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| 5. AUTHOR(S) (First name, middle initial, last name) Neville Jonathan |
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13. ABSTRACT Information concerning the initial distribution of energy in simple atom-molecule exchange reactions giving hydrogen fluoride is reported. The method used to obtain experimental data is that of infrared chemiluminescence using the flowtube technique. Population inversion of vibrational energy levels has been detected in all systems which have so far been studied. Potential energy surfaces are being developed which when used in classical trajectory calculations give a satisfactory prediction of the kinetic properties of the atomic hydrogen/F₂ reaction.

The progress in the use of vacuum ultraviolet photoelectron spectroscopy to detect transient species and obtain ionization potentials and information concerning ionic states is reviewed.

KEYWORDS: Infrared chemiluminescence, Chemical kinetics

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| 3. REPORT TITLE CHEMICAL REACTIONS KINETICS WITH METALLIC ATOMS | | 2b. GROUP |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final. | | Approved: 28 July 1972 14 April 1969 through 14 June 1972 |
| 5. AUTHOR(S) (First name, middle initial, last name) David O. Hansen Joseph F. Friichtenicht John M. Sellen, Jr. | | |
| 6. REPORT DATE 14 June 1972 | 7a. TOTAL NO. OF PAGES 83 | 7b. NO. OF REFS 6 |
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| b. PROJECT NO. Task, Work Unit Nos. 5710 - n/a - n/a | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL- 72-0366 AD748, 278 | |
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| 11. SUPPLEMENTARY NOTES This research was supported by the Defense Nuclear Agency. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (OP) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT The objectives of the program were to develop a pulsed atomic beam by the laser vaporization of high velocity microparticles and to use the pulsed atomic beam to measure several metal monoxide formation cross sections. An experimental system for irradiating high velocity particles was designed, built, and tested. Tests confirmed that the particles were vaporized by the laser bombardment, but the thermal (random) velocity distribution of vaporized atoms and ions resulted in a much lower than anticipated useful beam intensity. As an alternative approach, the laser bombardment of solid metallic targets was used to produce both ionic and atomic pulsed beams. Useful beam intensities in the energy range from ~ 1 to 100 eV were obtained for both ions and atoms of uranium thorium, aluminum, and iron. Generally, the entire energy spectrum was present in each pulse. Using time-of-flight techniques to specify the incident beam energy, cross sections for the reactions $U^+ + O_2 \rightarrow UO^+ + O$ and $Th^+ + O_2 \rightarrow ThO^+ + O$ were measured. For the UO^+ reaction, the cross section varied from $0.2 \pm 0.35 \times 10^{-15} \text{ cm}^2$ at a center-of-mass energy of ~ 9 eV to $5 \pm 3 \times 10^{-15} \text{ cm}^2$ at 0.1 eV. The corresponding values for the thorium reaction are $0.6 \pm 0.5 \times 10^{-15} \text{ cm}^2$ and $4.5 \pm 1.5 \times 10^{-15} \text{ cm}^2$. It was found that the ratio of reactive to elastic cross sections for the $A10^+$ and FeO^+ formation reactions were about 0.01 and 0.10, respectively. The $U + O_2 \rightarrow UO + O$ reaction was observed, but no quantitative data were obtained. The chemi-ionization reaction $U + O_2 \rightarrow UO^+ + O + e^-$ was also observed, but again only qualitatively. | | |
| KEYWORDS: Atomic beams, Ion beams, Reaction cross sections | | |

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| 3. REPORT TITLE LITHIUM-NICKEL SULFIDE BATTERIES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Final. Scientific | 1 April 1971 - 31 March 1972 - Approved 9/1/72 | |
| 5. AUTHOR(S) (First name, middle initial, last name) Lewis Gaines Raymond Jasinski | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PH) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Investigation of the high rate discharge performance of Ni_3S_2 indicated that rate capability was strongly influenced by the viscosity of the cell electrolyte. Stable discharges at up to 6 mA/cm^2 (equivalent to the 5-hr rate for an electrode of typical thickness) were obtained from Teflon-bonded electrodes in a tetrahydrofuran/ LiClO_4 electrolyte. Coulombic efficiencies on the order of 50% of theoretical could be obtained at 3 mA/cm^2 . Previous results with propylene carbonate and butyrolactone solutions indicated rate limitations in the vicinity of 0.5 to 1 mA/cm^2 . Study of the Ni_3S_2 oxidation procedure indicated that the optimum temperature for the production of the high voltage material was 325°C . X-ray diffraction analysis of the oxidized Ni_3S_2 indicated the presence of the relatively sulfur rich nickel sulfides: Ni_7S_6 and $\text{NiS}_{1.09}$. These materials possess higher theoretical energy densities than Ni_3S_2 . This advantage is compromised by the difficulty of obtaining high coulombic efficiencies from insulating materials. Oxidation of Ni_3S_2 at temperatures above 400°C results in the formation of NiO . A brief study of the discharge properties of metallic oxides, carbonates, and cyanides in propylene carbonate/ LiClO_4 electrolyte indicated that although several of these materials exhibited acceptable discharge and voltage efficiencies, none were of sufficient interest to justify further development. | | |
| KEYWORDS: Batteries, Lithium, Nickel sulfide, Organic electrolytes | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) UNITED AIRCRAFT CORPORATION Research Laboratories East Hartford, Connecticut 06108 | | 2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED |
| 2b. GROUP ----- | | |
| 3. REPORT TITLE RESEARCH INVESTIGATION OF THE GENERATION, MEASUREMENT, AND PROPERTIES OF PICOSECOND LASER PULSES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final. 1 January 1970 through 30 April 1972 | | |
| 5. AUTHOR(S) (Last name, first name, initial) Approved 16 June 1972 Glenn, William H. | | |
| 6. REPORT DATE 28 April 1972 | 7a. TOTAL NO. OF PAGES 108 | 7b. NO. OF REFS 11 |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (OP) L. G. Hanscom Field | |
| 13. ABSTRACT This report summarizes a number of research projects concerned with the generation, measurement, and properties of picosecond laser pulses produced by mode-locked lasers. Topics discussed include a theory of the two photon absorption-fluorescence method of pulse width measurement, a statistical model of the mode-locking process that is capable of explaining many of the observed features, a comparison of the model with experimental results, experiments with time-resolved spectroscopy and experiments with a novel type of nonlinear optical element that is potentially useful for mode-locking. | | |
| KEYWORDS: Ultrashort laser pulses, Picosecond laser pulses | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) University of Alaska Geophysical Institute Fairbanks, Alaska 99701 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
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| 3. REPORT TITLE PHENOMENOLOGY OF ARCTIC PARTICLE PRECIPITATION | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final. 1 March 1969 - 28 February 1972 | | Approved 14 June 1972 |
| 5. AUTHOR(S) (First name, middle initial, last name) Syun-Ichi Akasofu | | |
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| b. PROJECT, WORK UNIT NOS. 5631-14-01, 5710 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFRCL-72-0330 AD746, 283 | |
| c. DOD Element 61102F | | |
| d. DOD Subelement 681310 | | |
| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L.G. Hanscom Field, Bedford, Massachusetts | |
| 13. ABSTRACT The report describes briefly results of the projects which had been carried out in assisting the airborne operation of the AFCRL Flying Laboratory under Contract No. F-19628-C-0182. We analyzed most of all-sky photographs and some ionograms taken during the flights and ground magnetic records from auroral zone stations for all the flight periods. We have confirmed the existence of a circum-polar oval band of auroras, the auroral oval and the associated ionospheric structure during both quiet and disturbed periods (substorm periods). | | |
| KEYWORDS: Auroral oval, Magnetospheric substorm, Midday aurora | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| Geophysical Institute University of Alaska College, Alaska 99701 | | 2b. GROUP |
| 3. REPORT TITLE Spatial and Temporal Relations between Pi Bursts and IPDP Micropulsation Events | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Richard R. Heacock | | |
| 6. REPORT DATE July 1971 | 7a. TOTAL NO. OF PAGES 11 | 7b. NO. OF REFS 26 |
| 8a. CONTRACT OR GRANT NO. F 19628-68-C-0121 | 9a. ORIGINATOR'S REPORT NUMBER(S) Reprint | |
| b. Task, Work Unit Nos. 8601-03-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0473 AD747, 149 | |
| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from J. of Geophysical Research, Vol. 76, No. 19, pp 4494-4504, 1 July 1971 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (PH) L. G. Hanscom Field, Bedford, Mass. | |
| 13. ABSTRACT Temporal and spatial relationships are found between impulsive Pi bursts occurring near local midnight and IPDP events occurring in the afternoon-evening side. The Pi burst occurring at the onset of a polar substorm is followed immediately by the IPDP event in the late evening sector. The IPDP is registered most clearly equatorward and westward of the center of the Pi burst event. This morphology is consistent with the IPDP's generation by protons drifting westward from the midnight precipitation region. The IPDP's appear most clearly at sites in the 60° - 65° geomagnetic latitude range, whereas the Pi bursts are usually more prominent at 70°. Unstructured Pc 1-2 activity often precedes IPDP's and is most prominent near 70° latitude. If the midnight precipitation region spans both open and closed field lines, the westward drift of quasi-trapped protons on the innermost L shells may account for the IPDP events. | | |
| KEYWORDS: Micropulsations, Hydromagnetic waves, Magnetosphere | | |

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| (Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified) | | |
| 1. ORIGINATING ACTIVITY (Corporate author) University of California, San Diego Visibility Laboratory San Diego, California 92152 | | 2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED |
| 2b. GROUP | | |
| 3. REPORT TITLE AIRBORNE MEASUREMENTS OF OPTICAL ATMOSPHERIC PROPERTIES IN SOUTHERN GERMANY | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Interim. | | |
| 5. AUTHOR(S) (Last name, first name, initial) Duntley, Seibert O. Johnson, Richard W. Gordon, Jacqueline I. | | |
| 6. REPORT DATE July 1972 | 7a. TOTAL NO. OF PAGES 221 | 7b. NO. OF REFS 21 |
| 8a. CONTRACT OR GRANT NO. F19628-70-C-0054 | 9a. ORIGINATOR'S REPORT NUMBER(S) Scientific Report No. 1 SIO Ref. 72-64 | |
| b. Project, Task, Work Unit Nos. 7621-04-01 | | |
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| d. DoD Subelement 681000 | | |
| 10. AVAILABILITY/LIMITATION NOTICES Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Multiple reprints included | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (OP) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT | | |
| <p>This report presents atmospheric optical data collected in the daytime in Germany chiefly with airborne instruments during a field expedition in the spring of 1970. Results from six flights are presented. The data include irradiance, directional reflectance of terrain, total volume scattering coefficients, atmospheric beam transmittance, path radiance, and directional path reflectance. Data for sunlight and overcast conditions were derived for downward-looking paths of sight inclined at seven zenith angles (93, 95, 97, 100, 120, 150, and 180 degrees) from maximum altitudes of 2400 to 5100 meters AGL and lower in four spectral regions, as follows: two narrow band optical filters with mean wavelengths of 478 and 664 nanometers; and two broad band sensitivities, one representing the S-20 multiplier phototube incorporating an ultraviolet rejection filter with a mean wavelength of 532 nanometers, the other representing the photopic response with a mean wavelength of 557 nanometers.</p> | | |
| KEYWORDS: Albedos, Atmospheric optics, Atmospheric scattering coefficient | | |

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| 11. SUPPLEMENTARY NOTES This research was supported by the Advance Research Projects Agency. | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (OP) L. G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT | |

The stratospheric water vapor mixing ratio altitude profile has been derived from spectral observations of the downward night emission from the pure rotation water vapor lines in the 24 - 29 μ m region of the spectrum. The data were obtained during two balloon flights, made on 22 February 1971 and on 29 June 1971, using a balloon-borne spectral radiometer with $\sim 2 \text{ cm}^{-1}$ resolution. The observed radiances have been fitted to line by line - layer by layer radiance calculations, from which the water vapor mixing ratio between 10 and 30 km has been derived. The resulting mixing ratio altitude profiles from both flights show a broad minimum around 15 km and a broad maximum around 25 km with a range of values of $6 \times 10^{-7} \text{ g/g}$ to $4 \times 10^{-6} \text{ g/g}$.

KEYWORDS: Infrared emission spectra, Line by line model, H₂O mixing ratio

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| 1. ORIGINATING ACTIVITY (Corporate author) University of Florence Istituto Di Onde Elettromagnetiche Florence, Italy | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | 2b. GROUP |

3. REPORT TITLE

ADDENDUM TO REPORT OF THE JOINT SATELLITE STUDIES GROUP

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)

P. F. Checcacci

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| 6. REPORT DATE May 1972 | 7a. TOTAL NO. OF PAGES 59 | 7b. NO. OF REFS 41 |
| 8a. CONTRACT OR GRANT NO. AFOSR-72-2212 | 9a. ORIGINATOR'S REPORT NUMBER(S) | |
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| d. DOD SUBELEMENT 684643 | AFCRL-72-0402 AD747, 507 | |

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT This report is a collection of papers concerned with total ionospheric electron content and satellite signal scintillation along with the related measurement methods and techniques. The papers were presented at the 1971 meeting of the Joint Satellite Studies Group in Florence, October 1971.

KEYWORDS: Ionosphere, Total electron content, Scintillation, Satellite

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| 1. ORIGINATING ACTIVITY (Corporate author) | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| University of Florida Engineering and Industrial Experiment Station Gainesville, Florida 32601 | | 2b. GROUP |
| 3. REPORT TITLE A CENTER OF COMPETENCE IN SOLID STATE MATERIALS AND DEVICES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Fredrik A. Lindholm Larry L. Hench Eugene R. Chenette Sheng S. Li Robert W. Gould Aldert van der Ziel | | |
| 6. REPORT DATE 10 April 1972 | | 7d. TOTAL NO. OF PAGES 184 |
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| c. DOD ELEMENT 61101D | | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72- 0336 |
| d. DOD SUBELEMENT n/a | | |
| 10. DISTRIBUTION STATEMENT 1 A - Approved for public release; distribution unlimited | | |
| 11. SUPPLEMENTARY NOTES This research was supported by Advanced Research Projects Agency | | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LQ) L.G. Hanscom Field Bedford, Massachusetts 01730 |
| 13. ABSTRACT The increase in terminal currents and noise observed at high drain bias in MOS field-effect transistors is explained by quantitative models that give predictions in good agreement with experiment. We describe the fabrication and resulting properties of a new type of Schottky barrier photodiode. An explanation is proposed for the fall-off in quantum yield observed in metal-semiconductor photodiodes for excitation wavelengths in the near UV region of the spectrum. New results are given for the electron and hole capture rates associated with the defect centers produced by nickel in germanium. The results of basic optical and electrical measurements are reported for amorphous semiconductor $As_2Se_3Sb_2Se_3$ films fabricated by evaporation. Monochromated Guinier-deWolff and Guinier-Lenné x-ray powder cameras and a scanning microdensitometer are combined into a data system for studying solid state reaction kinetics. The changes in the short range ordered structure of an Ni_3Fe alloy are determined for a series of anneals between 0 and 40 hours at $480^{\circ}C$. | | |

KEYWORDS: Silicon, Noise, Photodetectors, Semiconductor devices

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| 1. ORIGINATING ACTIVITY (Corporate author) University of Illinois Department of Electrical Engineering Urbana, Illinois 61801 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE PROPAGATION AND APPLICATION OF WAVES IN THE IONOSPHERE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) K. C. Yeh C. H. Liu | | |
| 6. REPORT DATE May 1972 | 7a. TOTAL NO. OF PAGES 78 | 7b. NO. OF REFS 303 |
| 8a. CONTRACT OR GRANT NO. F19628-71-C-0013 | 9a. ORIGINATOR'S REPORT NUMBER(S) Reprint | |
| b. PROJECT, TASK, WORK UNIT NOS. 4643-01-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0403 AD746, 804 | |
| c. DOD ELEMENT 62101F | | |
| d. DOD SUBELEMENT 684643 | | |
| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Reprinted from Reviews of Geophysics and Space Physics, Vol. 10, No. 2, pp 631-709, May 1972 | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LI) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT This review deals with the propagation of waves, especially radio waves in the ionosphere. In the macroscopic electromagnetic theory, the mathematical structure of wave propagation problems depends entirely on the properties of the dielectric operator in a magnetically nonpermeable medium. These properties can be deduced from general discussions of symmetry and considerations of physical principles. When the medium is specifically the ionosphere, various physical phenomena may occur. Because of a large number of parameters, it is desirable to define a parameter space. A point in the parameter space corresponds to a specific plasma. The parameter space is subdivided into regions whose boundaries correspond to conditions of resonance and cutoff. As the point crosses these boundaries, the refractive index surface transforms continuously. The medium in which the propagation takes place may influence the wave in many different ways. Specific experiments can be designed to probe the medium to learn its properties. | | |
| KEYWORDS: Propagation of ionospheric radio waves, Waves in fluid plasmas | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Illinois State Water Survey University of Illinois Urbana, Illinois 61801 | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | 2b. GROUP |

3. REPORT TITLE

CLIMATOLOGY OF INSTANTANEOUS PRECIPITATION RATES

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| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific. Final (15 November 1968-14 November 1971) | Approved 8 Aug 72 | |
| 5. AUTHOR(S) (First name, middle initial, last name) Douglas M. A. Jones Arthur L. Sims | | |
| 6. REPORT DATE December 1971 | 7a. TOTAL NO. OF PAGES 46 | 7b. NO. OF REFS 7 |
| 8a. CONTRACT OR GRANT NO. F19628-69-C-0070 | 9a. ORIGINATOR'S REPORT NUMBER(S) | |
| b. PROJECT, TASK, AND WORK UNIT NO. 8624-01-01 | | |
| c. DOD ELEMENT 62101F | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0430 | |
| d. DOD SUBELEMENT 681000 | | |

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Labs. L. G. Hanscom Field (LK) Bedford, Massachusetts 01730 |
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13. ABSTRACT

Nearly instantaneous precipitation rates have been measured in several locations to develop point frequencies of occurrence of 1-minute rates. These are tabulated by months for about one year of data from locations in Florida, North Carolina, New Jersey, Alaska, and the Marshall Islands. Four-minute rain rates are tabulated for a very limited sample of data from Bogor, Indonesia.

Similar data for shorter periods of time have been derived for Flagstaff, Arizona, and Fort Sherman, Canal Zone. A four-year average table of frequencies has been derived for the summer months at a location near Tombstone, Arizona. Tables of 4-minute rates are included for three locations in Vietnam.

Two-minute average frequencies along lines of raingages have been tabulated for England and central Florida.

KEYWORDS: Instantaneous rainfall rates, Precipitation rates

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| 1. ORIGINATING ACTIVITY (Corporate author) University of Innsbruck Electronic Laboratory Innsbruck, Austria | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | 2b. GROUP |

3. REPORT TITLE

A DIGITAL PHASE MEASURING DEVICE

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

Scientific Interim

5. AUTHOR(S) (First name, middle initial, last name)

Dieter Fritz

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| 6. REPORT DATE 15 July 1972 | 7a. TOTAL NO. OF PAGES 19 | 7b. NO. OF REFS 2 |
| 8a. CONTRACT OR GRANT NO. F44620-72-C-0052 | 9a. ORIGINATOR'S REPORT NUMBER(S) | |
| b. PROJECT, TASK, WORK UNIT NOS. 4600-10-01 | Scientific Report No. 1 | |
| c. DOD ELEMENT 62702F | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) | |
| d. DOD SUBELEMENT 674600 | AFCRL-72-0551 | |

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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT With the device described it is possible to measure the mutual phase position of two signals with special consideration of the propagation of two signals with special consideration of the propagation of VLF and LF waves. The minimum operating input amplitude is selectable. The phase is indicated digitally and is independent on the amplitude and the frequency between 100 Hz and 100 kHz. The device is intended for battery operation (minimum current consumption). The errors resulting from the principle of measurement are calculated and methods are described to restrict them to a minimum. In addition to the block circuit diagram detailed connection diagrams are given.

KEYWORDS: Phase measurement for VLF waves, Digital phase

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| 1. ORIGINATING ACTIVITY (Corporate author) University of Maryland Computer Science Center College Park, Maryland 20742 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified |
| | | 2b. GROUP |
| 3. REPORT TITLE PAX USER'S MANUAL | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific, Interim. | | |
| 5. AUTHOR(S) (Last name, first name, initial) Emily G. Johnston | | |
| 6. REPORT DATE June, 1972 | 7a. TOTAL NO. OF PAGES 310 | 7b. NO. OF REFS 0 |
| 8a. CONTRACT OR GRANT NO. F19-628-70-C-0208 | 9a. ORIGINATOR'S REPORT NUMBER(S) Scientific Report No. 7 | |
| b. PROJECT, Task, Work Unit Nos. 5628-03-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0304 AD745, 973 | |
| c. DoD element 61102F | | |
| d. DoD Subelement 681305 | | |
| 10. AVAILABILITY/LIMITATION NOTICES A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES Tech, Other | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LR) L.G. Hanscom Field, Bedford, Massachusetts 01730 | |
| 13. ABSTRACT This report contains a description of the PAX picture processing software, formatted to be used as a user's manual. It contains a complete description of all subroutines, and instructions for usage on all computers for which PAX is currently implemented. | | |
| KEYWORDS: PAX, Picture processing, Image processing, Programming systems | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) University of Maryland Computer Science Center College Park, Maryland 20742 | | 2a. REPORT SECURITY CLASSIFICATION Unclassified 2b. GROUP |
| 3. REPORT TITLE NEW IMAGE PROCESSING TECHNIQUES | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Final (March 1, 1970 - June 30, 1972) | | Approved 17 Aug. 72 |
| 5. AUTHOR(S) (First name, middle initial, last name) Azriel Rosenfeld | | |
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| b. PROJECT, TASK, WORK UNIT NOS. 5628-03-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0431 AD748, 467 | |
| c. DOD ELEMENT 61102F | | |
| d. DOD SUBELEMENT 681305 | | |
| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited | | |
| 11. SUPPLEMENTARY NOTES Tech, other | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LR) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT This report summarizes research performed on Contract No. F19628-70-C-0208, A Study of New Image Processing Techniques, during the period March 1, 1970 - June 30, 1972. The areas investigated on this contract, as documented in Scientific Reports Nos. 1-7, were | | |
| <ol style="list-style-type: none"> 1) Detection of texture edges, spots and streaks in digital pictures 2) Computer synthesis of shapes 3) Grayscale transformations for digital picture analysis 4) Interactive, on-line output of continuous-tone pictures 5) Digital picture processing software (the PAX system). | | |

KEYWORDS: Picture processing, Image processing

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| 1. ORIGINATING ACTIVITY (Corporate author) The University of Michigan Radiation Laboratory 2216 Space Research Bldg., North Campus Ann Arbor, Michigan 48105 | | 2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED |
| | | 2b. GROUP ----- |
| 3. REPORT TITLE SCATTERING OF ELECTROMAGNETIC WAVES BY A PERIODIC SURFACE WITH ARBITRARY PROFILE | | |
| 4. DESCRIPTIVE NOTES (Type of report and inclusive dates) Scientific Interim | | |
| 5. AUTHOR(S) (First name, middle initial, last name) Tommy C-H. Tong Thomas B.A. Senior | | |
| 6. REPORT DATE April 1972 | 7a. TOTAL NO. OF PAGES 214 | 7b. NO. OF REFS 64 |
| 8a. CONTRACT OR GRANT NO. F19628-68-C-0071 | 9a. ORIGINATOR'S REPORT NUMBER(S) 013630-10-T Scientific Report No. 13 | |
| b. _____ Project, Task, Work Unit Nos. c. 5635-02-01 d. DoD Element 61102F e. DoD Sublement 681305 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0258 AD747, 491 | |
| 10. DISTRIBUTION STATEMENT A - Approved for public release; distribution unlimited. | | |
| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LZ) L. G. Hanscom Field Bedford, Massachusetts 01730 | |
| 13. ABSTRACT Numerical procedures are developed for the digital solution of the integral equations for the current induced on a perfectly conducting, two-dimensional periodic surface of arbitrary profile when a plane electromagnetic wave is incident. By using Floquet's theorem the range of integration is reduced to a single period, and special summation techniques consisting of a Poisson summation and the subtraction of the dc term are used to improve the convergence of the infinite series representation of the Green's function. The integral equations are then solved numerically using the moment method and an interpolation scheme. | | |
| Data are obtained for both the surface and far fields for a variety of sinusoidal, full-wave rectified, inverted full-wave rectified and triangular profiles for plane waves of either polarization at oblique as well as normal incidence, and the results are compared with the predictions of physical optics. | | |
| The numerical results are used to illustrate some interesting physical phenomena, notably the P-type and S-type Wood anomalies associated with the frequency and angular responses of diffraction gratings, and to develop a scheme to estimate back scattering from a sinusoidal surface at oblique incidence. | | |
| The knowledge gained in the study of scattering from periodic surfaces is then applied to the study of rough surfaces by treating the surface as a small scale roughness superimposed upon a periodic base (representing the large scale roughness). The small scale roughness is approximated by a random function with a Gaussian distribution. | | |
| KEYWORDS: Periodic surfaces, Diffraction gratings, Surface currents | | |

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| 1. ORIGINATING ACTIVITY (Corporate author) Electronic Sciences Laboratory University of Southern California Los Angeles, California 90007 | 1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED |
| | 2b. GROUP |

3. REPORT TITLE
STUDY THE DEFECT STRUCTURE OF THE SEMICONDUCTING
III - V COMPOUNDS AND OTHER RELATED MATERIALS

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)
Scientific Final, 1 January 1968 - 31 March 1972 Approved 19 Jul 1972

5. AUTHOR(S) (First name, middle initial, last name)

William G. Spitzer

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| 6. REPORT DATE 27 April 1972 | 7a. TOTAL NO. OF PAGES 52 | 7b. NO. OF REFS 25 |
| 8a. CONTRACT OR GRANT NO. F19628-68-C-0169 | 8b. ORIGINATOR'S REPORT NUMBER(S) USCEE No. 421 | |
| b. PROJECT NO., Task, Work Unit Nos. 5621-08-01 | 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report) AFCRL-72-0296 | |
| c. DoD Element 61102 F | | |
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| 11. SUPPLEMENTARY NOTES TECH, OTHER | 12. SPONSORING MILITARY ACTIVITY Air Force Cambridge Research Laboratories (LOR) L. G. Hanscom Field Bedford, Massachusetts 01730 |
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13. ABSTRACT
This final report summarizes the research efforts on a series of projects. In all cases the research concerns the vibrational properties of imperfect systems, and the systems include Li-diffused GaAs, Si-doped GaAs, Ge_xSi_{1-x}, Ion implanted Al and P in GaAs, and Mg-doped GaAs. The results include the identification of two different Li complexes in GaAs, the determination of the Si complexes in GaAs, the lattice and local mode absorption in GeSi alloys and the ion-pairing between Mg and Li in GaAs. The information obtained is compared with results of other measurements and in some cases comprehensive models of the dominant defects are developed.

KEYWORDS: Lattice dynamics, Localized excitation, Localized phonons

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| 13. ABSTRACT This report presents the results of an analysis of the vibrational relaxation of a combustion gas mixture in an expanding core flow field of both a conical and contoured nozzle. The species considered are CO, H ₂ , CO ₂ , and H ₂ O while the vibrational excitation is characterized through the species CO(v=1), H ₂ (v=1), CO ₂ (v ₃), CO ₂ (v ₂), H ₂ O (v ₃) and H ₂ O (v ₂). It is found in this analysis that the vibrational modes of the diatomics effectively freeze at the nozzle exit conditions, the v ₂ modes of the polyatomics stay close to equilibrium with the decreasing kinetic temperature while the v ₃ modes freeze at intermediate values between the exit temperature and the decreasing kinetic temperature. The sensitivity of the vibrational relaxation to the assumed rate coefficients is discussed together with the influence of downstream shock structure. | | |
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| 13. ABSTRACT Under Contract No. F19628-69-C-0255 with the Atmospheric Structure Branch of the Aeronomy Laboratory of the Air Force Cambridge Research Laboratories, L. G. Hanscom Field, Bedford, Massachusetts, personnel, services, materials, and facilities were provided for participation in the performance of applied research and development on rocket payload instrumentation. Included therein were payload integration and field support for experimental rocket systems used to determine upper atmosphere density in the altitude region above 100 km, as well as the fabrication of the basic rocket payload hardware, such as special nose cones, upper and lower sphere holders, sphere ejection devices, radar transponder assemblies, and the transition sections for mating the rocket and payload components. Also included were the improvement of the ground-based telemetry apparatus for the experimental payload, the investigation of devices for increasing the range and reliability of high altitude density measurements, participation in the launching of the rocket-borne experiments at sites designated by the Air Force Cambridge Research Laboratories, and the processing of flight data. | | |
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| 13. ABSTRACT The behavior of various low boiling-point, electrophilic chemical additives in a nitrogen-oxygen plasma was studied by using a K-band microwave horn probe and an S-band stripline probe. Test results show that Freon 113, Freon C-51-12, trichloroethylene, and carbon tetrachloride, which previously have been found to be excellent additives for the enhancement of microwave transmission through an argon plasma, are also very effective in removing free electrons and improving microwave transmission through the nitrogen-oxygen plasma. The principles of operation of the K-band microwave horn system and the S-band stripline diagnostic system are briefly discussed. | | |
| Flight data obtained from a two-coil conductivity probe constructed under the previous contract for the measurement of plasma electrical conductivity of a re-entry nose cone were analyzed. The measured conductivity of the plasma near the vehicle surface was found to be orders of magnitude lower than the theoretical estimate. This discrepancy was tentatively explained in terms of a non-uniform plasma resulted from electron depletion due to recombination on the vehicle surface. A plasma conductivity profile was obtained by using a two-parameter fit of the spatial variation of the plasma conductivity near the vehicle surface based on two measurements obtained from the two separate sensing coils. New design concepts for the refinement of the conductivity coil probe are also indicated. | | |
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